Records of the Australian Museum (2002) Vol. 54: 41–70. ISSN 0067-1975

New Genera of Phreatoicidea (Crustacea: Isopoda) from Western Australia

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ABSTRACT. Three new species belonging to new monotypic genera from Western Australia are added to the phreatoicidean isopod family Amphisopodidae: *Eremisopus beei* n.gen., n.sp. from the northwestern Kimberley region, *Peludo paraliotus* n.gen., n.sp. from Cape le Grand on the southern coast, and *Platypyga subpetrae* n.gen., n.sp. from Stirling Range. All species are illustrated using scanning electron micrographs. Both Ciliophora and ostracode Crustacea were found as epibionts on these species. All three isopod genera have highly restricted geographic distributions and could be threatened by anthropogenic degradation of their environments. Western Australia now has eight described genera of Amphisopodidae and Hypsimetopodidae, a generic diversity similar to Tasmania. Members of the Phreatoicidae, however, are absent in Western Australia. The distribution of Western Australian phreatoicideans suggests that they may have originally diversified in East Gondwana, while the Phreatoicidae show relationships to West Gondwana. A key to genera of Western Australia Phreatoicidea is included.

WILSON, GEORGE D.F., & STEPHEN J. KEABLE, 2002. New genera of Phreatoicidea (Crustacea: Isopoda) from Western Australia. *Records of the Australian Museum* 54(1): 41–70.

The description of two new isopod genera in the suborder Phreatoicidea (Wilson & Keable, 1999; Knott & Halse, 1999) and a new species of *Crenoicus* (Wilson & Ho, 1996) foreshadow the existence of considerable undescribed diversity in this suborder. The systematics, evolutionary history and biogeography of the Phreatoicideans have been treated elsewhere (Wilson & Johnson, 1999; Wilson & Keable, 2001). In this paper, we add three new genera from Western Australia (*Peludo, Eremisopus*, and *Platypyga*), that were introduced as undescribed taxa in previous papers. These new genera further extend the morphological diversity of the Phreatoicidea, which will allow the relationships of its component taxa to be assessed from any systematic level. Such data are relevant, given the basal phylogenetic position accorded to the suborder (Wägele, 1989; Brusca & Wilson, 1991), and their Palaeozoic fossil record (Wilson & Keable, 2001). Although not considered here, the proposed sister group relationship between Insecta and malacostracan crustaceans (K. Wilson *et al.*, 2000), or even between insects and isopods (Brusca, 2000), may be assessed using data from our figures. If any detailed external morphological synapomorphies of malacostracans and insects exist, they may be illustrated in this paper.

As part of our ongoing program to revise the suborder, we also provide a key to the genera found in Western Australia. Epibionts, conservation and biogeography of the new phreatoicidean taxa are discussed to provide new knowledge of the Gondwanan fauna of Western Australia, in which phreatoicideans often are listed as a minor component (e.g., Hopper *et al.*, 1996).

Methods

Specimens were either preserved in 95% ethanol, or were fixed in 4% formaldehyde in the field and later transferred to 80% ethanol for storage. Preparation for scanning electron microscopy (SEM) involved rehydrating specimens and dissected parts, cleaning using an ultrasound bath, and dehydrating the specimens through an alcohol series to absolute ethanol. Drying the specimens for SEM was accomplished using either a carbon dioxide critical point method, or by transferring the specimens to hexamethyldisilizane and then slowly air drying in a covered glass petri dish. Dissected parts were mounted vertically on SEM stubs using double adhesive carbon spots, or attached to small wires and clamped in a small vice. Specimens were imaged either on a LEO or a Cambridge scanning electron microscope and digital images were saved for later processing. Digital image microphotographs were taken using a Leica MZ8 dissecting microscope with an attached Pixera PVC100C camera connected to a computer. For calibration, a one-mm grid was photographed at all scales used. All images were processed using Adobe PhotoShop (ver. 5). After deleting the background, the plates were assembled by pasting each image into a transparent layer over a black background. Contrast, brightness and greyscale tones of each image were adjusted to standardise their appearance. In a few instances, some images were rescaled to match other images (e.g., pereopods).

Descriptions and the key were generated using the taxonomic database system DELTA (Dallwitz, 1980; Dallwitz *et al.*, 1999; Wilson & Keable, 1999, 2001).

Implicit characters

Unless indicated otherwise, the following characters are implicit in the descriptions; i.e, these character states are present but are not included in the description. This device is used to shorten the species descriptions so that characters applicable to most but not all phreatoicidean species are not constantly repeated. Implicit characters may appear explicitly in species descriptions but only if the states differ from the norm (e.g., representing autapomorphies or restricted synapomorphies). Features found in all three species described in this paper (but not necessarily most phreatoicideans) are also included in the following list of character states.

Head tubercles absent. Frontal process above antennula absent. Mouth field angling ventrally, mandibular insertion axis in lateral view nearly level, line projected anteriorly along mandibular insertion passing below base of antenna. *Pereonites* 2–4 lacking lateral tergal plates. *Pleonites* in lateral view much deeper than pereonites, with large pleurae, basal region of pleopods not visible; pleonite 1 pleura distinctly shallower than pleurae of pleonites 2–5. Pleonite 5 lacking dorsal median ridge. *Pleotelson* median dorsal ridge absent; lateral dorsal ridges absent. Posterior margin elongate pappose setae absent. Dorsal uropodal ridge terminating at pleotelson margin above uropods. *Antennula* article 4 shorter than article 3. Terminal article shorter than penultimate article. Penultimate article width approximately subequal to ante-penultimate article width. *Labrum* dorsal margin approximately same width as clypeus. *Mandible* palp article 1 well developed, easily visible. Incisor processes broad, width greater than thickness. Left incisor process with 3 distal cusps and 1 on dorsal margin. Left lacinia mobilis with 3 cusps. Right incisor process with 4 cusps. Right lacinia mobilis large, well separated and distinct from remainder of spine row, with two dentate plates, smaller plate on anterior surface of larger plate. Spine rows on projecting ridge between incisor and molar, distal margin protruding in ventral view relative to proximal margin, basal insertions crossing dorsally and then abruptly angling posteriorly. Spine rows with bifurcate spines, basal insertions in line between incisor and molar processes. Left spine row with first spine not separated from remaining spines. Molar process stout, heavily keratinised, wider than long; triturating surface heavily ridged, fine simple setae forming posterior row. *Maxilliped* endite distal tip with multiple subdistal biserrate setae on ventral surface. Palp article 4 shape subcircular. *Pereopod I* dactylus dorsal margin dense group of elongate setae absent; ventral margin midlength spine-like projection absent. Propodus palm ridge with low conical setae absent. Basis ventrodistal margin with multiple elongate setae; anteroproximal surface without dense group of setae. *Pereopod IV* dactylus distal accessory claw-spines present. Propodus articular plate on posterior side of limb present. *Pereopod VII* basis dorsal ridge distal margin indented. *Pleopod* exopods II–V proximal article distolateral lobes shorter than distal article. Endopods unilobed. Protopods I–II lateral epipods absent, III–V lateral epipods lobe-like. Pleopod I exopod ventral surface flat. Pleopod II endopod appendix masculina curved, distal tip margins smooth; endopod distal margin rounded; exopod distal segment longer than wide. *Uropod* protopod distomedial row of closely spaced setae absent; dorsolateral margin setae robust and simple; ventral ridge without rows of long laterally projecting setae. Endopod subequal-longer than exopod; spine on dorsal margin absent. Exopod shorter than pleotelson.

Key to the Western Australia genera of the Phreatoicidea

1 Pleotelson lateral lobes absent 2

—— Pleotelson lateral lobes forming vertical plates (Fig. 2E) 4

2(1) Pleotelson posterior margin entire (Figs. 1C, 2G); pleonites in lateral view much deeper than pereonites, with large pleurae, basal region of pleopods not visible ..... *Crenisopus* Wilson & Keable, 1999

—— Pleotelson posterior margin cleft, flattened (Figs. 15, 21A–C); pleonites in lateral view much deeper than pereonites, with large pleurae, basal region of pleopods not visible (Fig. 15A) ..... *Platypyga* n.gen.

—— Pleotelson posterior margin broadly indented; pleonites in lateral view having depth equal to depth of pereonites, without pleurae, basal region of pleopods visible 3

3(2) Uropod protopod dorsomedial ridge produced, spur-like; pereopods II–III propodus articular plate absent; pereopod IV prehensile, sexually dimorphic ..... *Hyperoedesipus* Nicholls & Milner, 1923

—— Uropod protopod dorsomedial ridge not produced; pereopods II–III propodus articular plate present; pereopod IV simple, not prehensile ..... *Pilbarophreatoicus* Knott & Halse, 1999

4(1) Pleotelson posterior margin entire (Figs. 1C, 2G, 9) 5

—— Pleotelson posterior margin cleft ..... *Amphisopus* Nicholls, 1926

5(4) Antennal notch deep, with posterior extension; all body and limb surfaces covered with dense cuticular hair (Fig. 8A,C–E); mandibular palp article 1 tiny (difficult to see among cuticular hairs on mandible) (Fig. 10A,C) ..... *Peludo* n.gen.

—— Antennal notch shallow, without posterior extension (Fig. 2A); body surfaces and limbs lacking dense cuticular hair; mandibular palp article 1 large and distinct (Fig. 3D) ..... *Eremisopus* n.gen.

—— Antennal notch absent; body surfaces and limbs lacking dense cuticular hair; mandibular palp article 1 large and distinct ..... *Paramphisopus* Nicholls, 1943

Amphisopodidae Nicholls, 1943

Remarks. Apomorphies of the Amphisopodidae include an oblique compound terminal article of the antennula, plates on the dorsal margin of the posterior pereopodal bases (always on the seventh pereopod) and pleotelson lateral lobes formed into vertically-oriented plates. Our phylogenetic evidence suggests, albeit weakly, that all three new genera described in this paper are members of the Amphisopodidae. *Eremisopus* n.gen. and *Peludo* n.gen. are related to *Eophreatoicus* Nicholls, 1926, with Eremisopus and *Eophreatoicus* as sister taxa. *Platypyga* n.gen., on the other hand, is not clearly associated with any clade within the Amphisopodidae in our current analyses (unpublished data), and lacks basal apomorphies of this family. If our presumed homology of the posteriorly cleft pleotelson is correct (discussed below), *Platypyga* n.gen. could be a sister group to a clade containing *Amphisopus* Nicholls, 1943 and *Phreatomerus* Sheppard, 1927. *Platypyga* n.gen. has mandibular similarities with members of the Amphisopodidae (particularly the form of the spine row), although the presence of the right lacinia mobilis is plesiomorphic for the Phreatoicidea (Wilson & Keable, 1999, 2001). Plate-like lateral lobes oriented vertically on the pleotelson, a synapomorphy of amphisopodids, are absent in *Platypyga* n.gen. This absence could be secondary, owing to the substantial modification of the pleotelson in *Platypyga*. Most amphisopodid taxa, except for *Platypyga* n.gen., also have a dorsomedial plate on the uropodal protopods. This absence also may be related to the modified configuration of the pleotelson in *Platypyga*. We consider the inclusion of *Platypyga* n.gen. in the Amphisopodidae to be provisional, and requiring further evidence.

The creation of three additional monotypic genera in the Phreatoicidea might seem excessive; our research (unpublished data), however, has shown that phreatoicidean taxa tend to form morphological and geographic clusters of species. The described species that we have scored from two multispecies amphisopodid genera, *Amphisopus* (*A. lintoni, A. annectans*) and *Mesamphisopus* Nicholls, 1943 (*M. capensis, M. abbreviatus*) show close similarities among congeners, morphometric distances (as calculated using the DIST tool in DELTA (Dallwitz *et al.*, 1999) from the cladistic characters in our dataset) of 0.04–0.05, while between generic distances are 0.3–0.37. The new taxa show distances of 0.18–0.36 from *Amphisopus* and *Mesamphisopus*, and 0.3–0.32 from each other. By comparison, the greatest distance observed in our database (0.62—occurring between *Nichollsia kashiense* Chopra & Tiarari, 1950 and *Crenoicus harrisoni*) is indicative of the morphometric differences between two families (Hypsimetopodidae and Phreatoicidae, respectively). Undescribed new species in currently monotypic genera (*Pilbarophreatoicus*—1–2 new species; *Eophreatoicus*, the sistergroup of *Eremisopus* n.gen.—up to 14 new species; 1 new species each for *Synamphisopus* Nicholls, 1943 and *Phreatoicoides* Sayce, 1900 described in Wilson & Keable, in press) also show similar low morphometric distances between congeners. Therefore, we do not believe that genera have been defined too finely, resulting in too many monotypic taxa.

Overall, genera in the Phreatoicidea tend to differ in the armament of the pereon, pleotelson and uropods, while species variation may be much more subtle. In the following, each species is diagnosed only once at the generic level because they belong to monotypic genera. Without having identified additional species in each genus, we cannot provide a more inclusive species diagnosis at this time.

Eremisopus n.gen

Type Species. *Eremisopus beei* n.sp.

Etymology. "*Eremisopus*" is derived from the Greek (gender masculine) for "lonely isopod", because this taxon has been found only in a single isolated stream near PAGO Mission, north of Kalumburu in the NW Kimberley.

Diagnosis. Pleonite 5 with dorsal median ridge. Pleotelson with dorsal median ridge and posterolateral ridges confluent with posterior margin; median lobe broad, with concave dorsal surface; postanal ridge triangular in ventral view, with robust setae at posterior apex; lateral lobes forming large vertical plates; dorsal uropod ridge curving strongly and extending posteriorly from uropods on pleotelson margin. Antennal flagellum proximal articles with dense cuticular hairs in male (fewer in females). Pereopod I dactylus distinctly shorter than propodal palm, propodal palm of male with approximately 30 robust setae. Pereopod V–VII basis with dorsal ridge plates as wide as basis shaft. Pereopod VII ischium dorsal ridge forming flange less than shaft width. Pleopods I–III protopods only with coupling hooks; pleopod II with lobe-like lateral epipod, appendix masculina shorter than endopod length, setose along entire margin. Uropod protopod dorsomedial plate higher than depth of protopodal shaft, with row of robust setae; rami distal tips pointed.

Remarks. *Eremisopus* n.gen. shares several character states with *Eophreatoicus* species including a plate-like ridge on the ischium of the posterior pereopods, a uropodal ridge on the pleotelson that curves smoothly toward the posterior margin, and a first pereopod with numerous conical stout setae and a dactylus shorter than the palm. Some, but not all, *Eophreatoicus* species also have a dorsal midline ridge on the pleotelson, similar to *Eremisopus*. A large postanal ridge of the pleotelson with stout setae is also present in both taxa, although more strongly developed in *Eophreatoicus*. The two genera differ in the size of the dorsal plate on the ischium of pereopod VII, being smaller in *Eremisopus*, as well as the presence of pleotelson lateral ridges in *Eremisopus*.

Eremisopus beei n.sp.

Figs. 1–7

"New Genus 3": Wilson & Johnson, 1999: 265, fig. 1.
"New Genus X3": Wilson & Keable, 2001, table 1.

Type material. HOLOTYPE ♂, WAM C 25049, bl 29.7 mm (formalin preserved), water temperature 24°C, depth 20 cm, slow flowing, 20 May 1997, C. Bee, D. Wilson & B. Hanson, 17 May, 1997. PARATYPES: formalin fixed—AM P60527, 6 ♂♂ (including 2 with exuvia, male "B" dissected to examine gut), 2 ♀♀ (including female "A" 22.6 mm, with exuvia, dissected for description), 2 mancas (offspring of female "A")—all collected originally as for holotype then kept in aquaria for various lengths of time; AM P61456, ♂ "D" bl 32.1 mm (dissected for description and illustration including; mouthparts, pereopods and pleopods), collection details as for AM P60527; AM P60528, 47 ♂♂, 2 ♀♀ (in amplexus with males), collection details as for holotype except—14°10.55'S 126°41.39'E (GPS), 26.0°C, pH 6.0, under rocks with gravel in flowing water, W. Ponder & G. Wilson, 18 June 1999, sample number WA576; AM P60529, 37 ♀♀, 5 indeterminate specimens, collection details as for AM P60528; WAM C 25050, ♂ bl 26.4 mm, 2 ♀♀ bl 17.3 mm, collection details as for AM P60528; AM P60530, female "D" bl 20.9 mm (dissected for pleopod description and illustrations), collection details as for AM P60528; AM P61453, ♂ bl 29.2 mm (dissected for SEM of mandibles), collection details as for AM P60528; AM P61454, ♂ bl 31.3 mm (dissected for SEM), collection details as for AM P60528; AM P61455, ♀ bl 18.6 mm (dissected for SEM) collection details as for AM P60528; ethanol preserved—AM P60531, 28 ♂♂, 11 ♀♀, 3 indeterminate specimens, collection details as for AM P60528.

Type locality. "South Creek", stream crossing road between Honeymoon Bay and PAGO Mission ruins, near Kalumburu Township, 15 km northeast of Honeymoon Beach, Western Australia, 14°10.529'S 126°41.408'E (GPS), fine sand, under rocks.

Etymology. We are grateful to Mr Cameron Bee who brought this species to our attention, hence the species name "*beei*" in his honour.

Diagnosis. See generic diagnosis.

Description based on male. *Colouration* in 70% ethanol cream-yellow with dense covering of grey chromatophores, chromatophores less dense on pereopods and pleonites than on pereonites. Live colour similar, but whiter under dark chromatophores.

Head (Figs. 1A,B, 2A) length shorter than width in dorsal view; width 0.82 pereonite 1 width; lateral profile of dorsal surface smoothly curved; surface rough; setae absent. Eyes bulging dorsolaterally; maximum diameter 0.25–0.33 head depth; dorsal margin convex, ventral margin straight; orientation of longest axis between horizontal and vertical; ocelli distinguishable as individual units (etched on surface, pigment not clearly segmented), pigmentation dark. Cervical groove sigmoidal, extending nearly to dorsal margin of head. Mandibular groove smoothly indented. Mandibular notch present. Clypeal notch present. Antennal notch shallow, without posterior extension. *Pereon* (Fig. 1A) broad, width exceeding head width (1.23 times); dorsal surface with transverse ridges, with scattered roughness, and smooth (roughness tending to be on posterior and lateral surfaces); setae on dorsal surface scattered, fine. Pereonites 2–7 in dorsal view wider than long. Coxal articulation of pereonites 2–4 fused (but with partial lateral suture more strongly developed in female than male), 5–7 free. Sternal processes absent. Typhlosole minimal, ventral invagination forming inverted U-shape in cross section (weak invagination); hindgut caecae absent. *Pleonites* (Fig. 1A) in dorsal view 2–4 respective lengths more than half the length of pleonite 5, 1–4 relative lengths subequal, 1–4 width 0.87 composite length in dorsal view. Pleonite 5 with dorsal median ridge. *Pleotelson* (Figs. 1A,C, 2E–G) lateral length 0.15 body length, 0.73 depth; dorsal length 1.35 width; depth 1.3 pereonite 7 depth. Posterior margin entire, reflexed dorsally, without irregular denticulations; median lobe width 0.5 pleotelson width, produced, greatest length 0.35 pleotelson total length; lateral lobes narrower than median lobe, distinct from median lobe, not extending posteriorly to median lobe, medial length 0.35 pleotelson total length; median lobe with 4 robust sensillate setae (on margin, ventral postanal ridge with a row of 10); lateral lobes with 2 robust sensillate setae. Dorsal uropodal ridge without setae. Ventral margin anterior to uropods with robust setae, setae denticulate and smooth, 17 altogether (approximately), posterior seta larger than anterior adjacent setae. *Antennula*

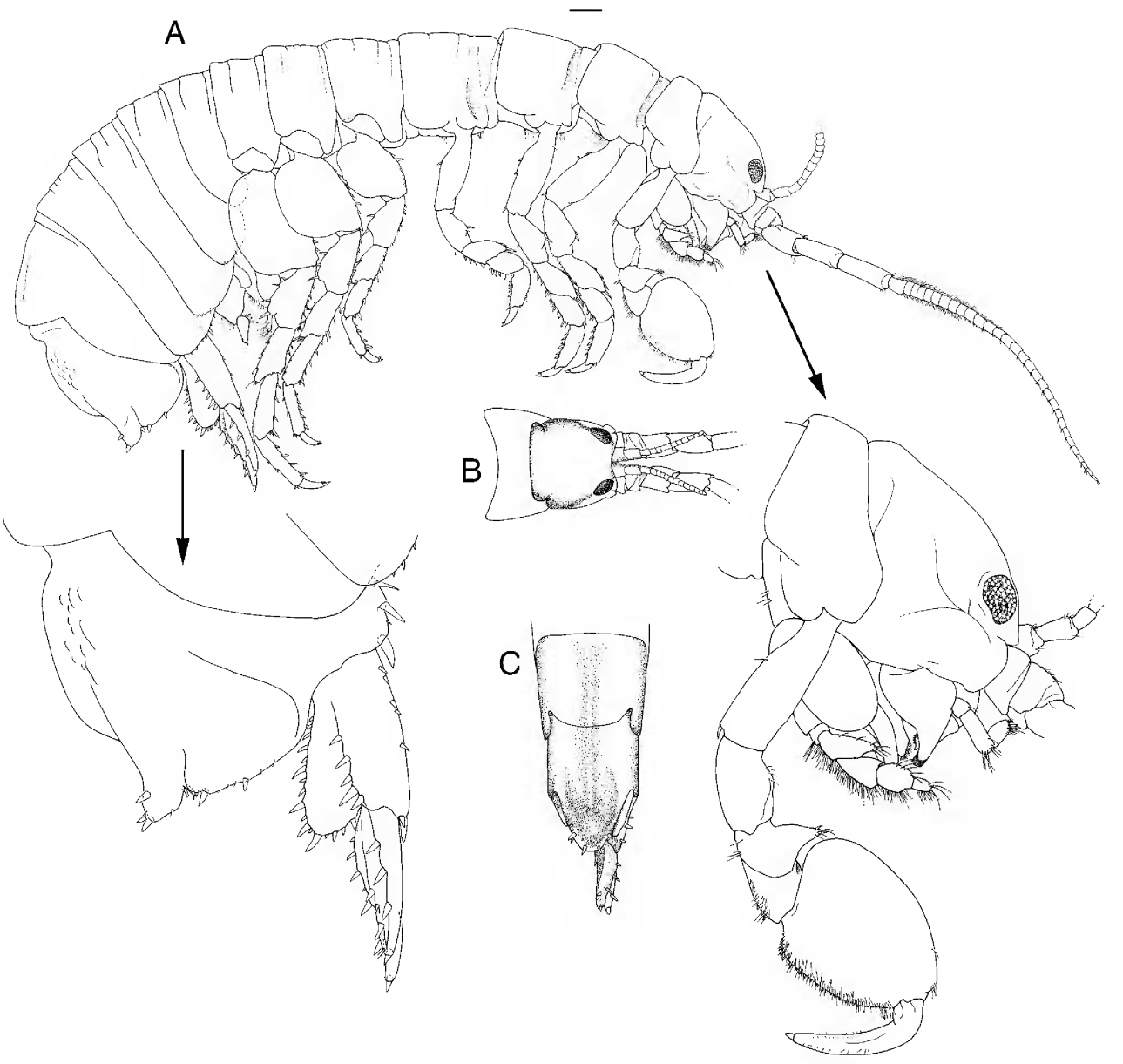

Figure 1. *Eremisopus beei* n.gen., n.sp. Holotype (WAM C 25049). A, lateral view, with enlargements of head and pleotelson; B,C, dorsal views of head and pleotelson. Scale bar 1 mm.

(Fig. 2A,B) length 0.1 body length, with 15 articles. Tiny aesthetascs on article 7 to terminal article. Terminal article distally oblique, with 2 or more groups of aesthetascs. Penultimate article length approximately subequal to length of other articles. Distal articles oval. *Antenna* (Figs. 1A, 2C,D) length 0.42 body length. Flagellum length 0.62 total antenna length, with 27 articles. Propodal article 1 absent. Article 5 longer than article 4, article 6 shorter than articles 4 and 5 combined. *Mouthfield* clypeus consisting of broad asymmetrical bar, rounded at mandibular fossae and with concave lateral margins, width 0.43 head width. Labrum weakly angular ventrally, appearing shield shaped to semicircular in anterior view. Paragnaths (Fig. 4A) with distolaterally rounded lobes, slightly produced distomedially, having medial and lateral setal rows and thickened medial base covered with dense long, fine setae. *Mandible* (Fig. 3) palp length 0.83 mandible length. Left spine row with 12 spines, 6 of which are bifurcate. Right spine row with 11 spines, 5 of which are bifurcate. Molar process length subequal to width; with 1 tooth, fine simple setae forming posterior row (implicit character state: dense along posterolateral margin). *Maxillula* (Fig. 4B) medial lobe length 0.82 lateral lobe length; width 0.63 lateral lobe width; with 4 pappose setae; with 1 "accessory" seta, on distolateral margin, "accessory" setae simple; with 1 short weakly setulate seta on distal tip (weakly serrate). Lateral lobe distal margin with 8 denticulate robust setae, with 5 smooth robust setae; ventral face with 3 plumose setae (although only 1 of these appears to have setules on both margins). *Maxilla* (Fig. 4C) medial lobe width 1.52 outer lateral lobe width; proximal portion smoothly continuous with distal portion; proximal and distal setal rows continuous. Outer lateral lobe longer than inner lateral lobe, width subequal to inner lateral lobe. *Maxilliped* (Fig. 4D–F) epipod distal tip rounded. Endite medial margin with 3 coupling hooks on left side, 4 on right side; dorsal ridge with 24 large distally denticulate plumose setae (approximately, 8 are only distally denticulate, with one row of fine setules).

Figure 2. *Eremisopus beei* n.gen., n.sp. A,E,F,G(enlargement), paratype ♀ (AM P61455); B–D,G, paratype ♂ (AM P61454). A, head, lateral view; B, antennula; C,D, antenna, with enlargements of basal and proximal articles; E–G, pleotelson, lateral, ventral and dorsal views, with enlargements of uropods and dorsal surface. Scale bar 1 mm.

Pereopod I (Fig. 5A–D) dactylus ventrodistal margin smooth, with one distal accessory claw (heavy setae), distal accessory spines absent. Propodus dorsal margin proximal region protruding beyond distodorsal margin of carpus. Propodal palm convex to straight, spine-like projections absent; cuticular fringe weakly developed; stout denticulate

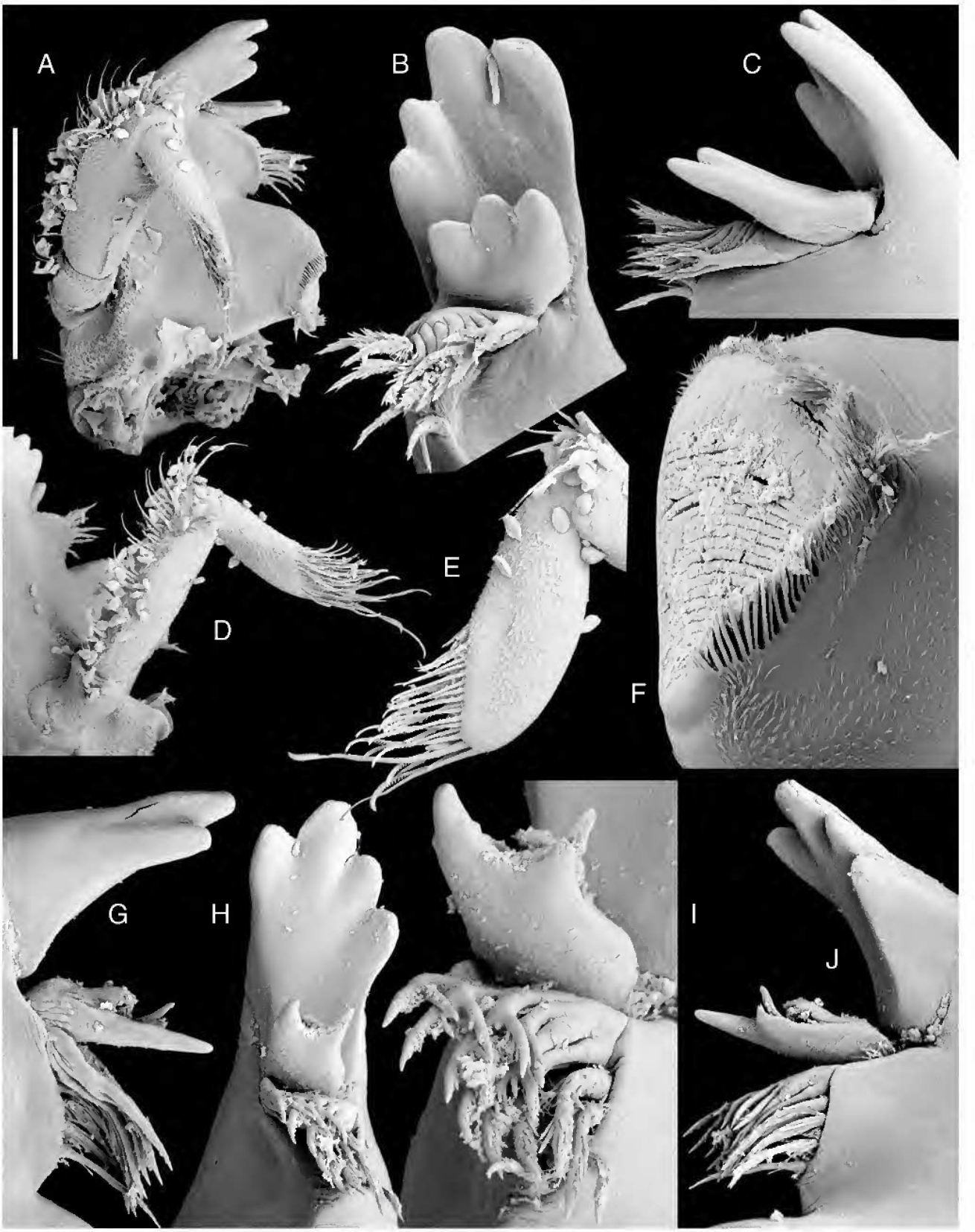

Figure 3. *Eremisopus beei* n.gen., n.sp. A,C–J, paratype ♂ (AM P61453); paratype ♂ (AM P61454) B. A–F, right mandible; G–J, left mandible. Scale bar 0.5 mm.

setae absent; stout robust simple setae conical; elongate broad based setae absent. Merus dorsal margin projection shelf-like and U-shaped, with 1 or 2 robust simple setae. Basis ventrodistal margin elongate setae absent. *Pereopods II–III* (Fig. 6A,B) dactylus without spines on ventral margin; with 1 distal accessory claw. Propodus articular plate present. Basis dorsal ridge in cross section angular and produced but not forming distinct plate. *Pereopod IV* (Fig.

Figure 4. *Eremisopus beei* n.gen., n.sp. Paratype ♂ (AM P61454). A, paragnaths; B, maxillula; C, maxilla; D–F, maxilliped. Scale bar 0.5 mm.

6C–E) subchelate with major hinges on dactylus-propodus. Dactylus length subequal to propodal palm (shorter in female). Propodus with 8–10 broad based setae on ventral margin, 2 distinctly larger than others; subequal in length to dactylar claw. Basis dorsal ridge in cross section angular and produced but not forming distinct plate. *Pereopods V–VII* (Fig. 6F–J) dactylus with 1 distal accessory claw; spines absent. Propodus articular plate on posterior side of limb present. Basis dorsal ridge distinctly separated from basis shaft, in cross section produced and forming distinct plate. Pereopod VII basis dorsal ridge distal margin rounded. *Penes* (Fig. 6I) curved posteriorly; length 0.18 body width at pereonite 7, extending to midline; smooth, lacking setae, distally tubular; distal tip rounded. *Pleopod* (Figs. 5H, 7)

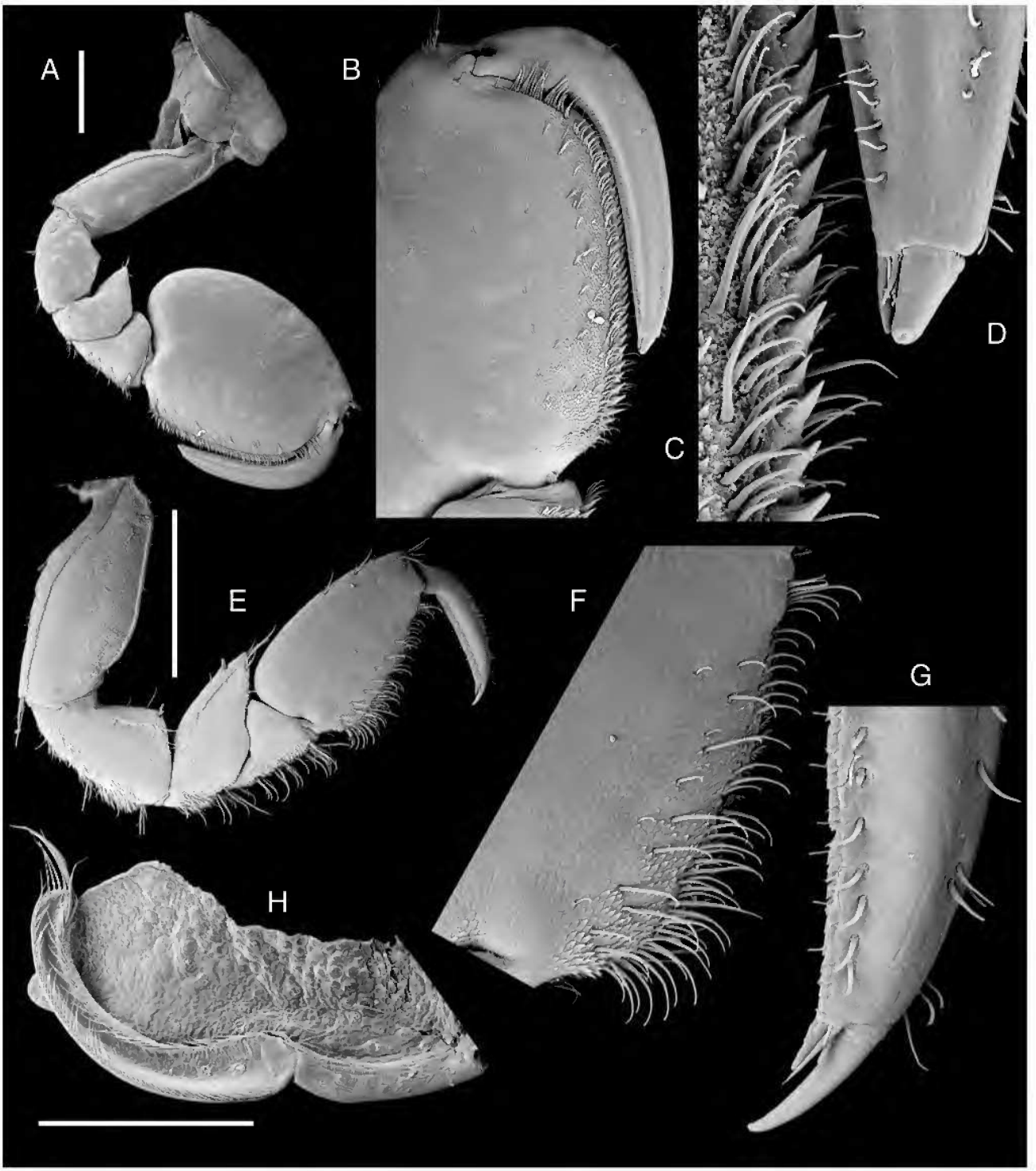

Figure 5. *Eremisopus beei* n.gen., n.sp. Paratype ♂ (AM P61454); paratype ♀ (AM P61455). A–D, ♂ pereopod I; E–G, ♀ pereopod I; H, ♂ pleopod II appendix masculina and endopod. Scale bar 1 mm.

exopods lateral proximal lobes on II–V, medial proximal lobes on II–V. Endopods I–V with setae on margins (sparse, on lateral proximal margin only), setae simple on all (mixed with minutely serrate setae). Protopods II–V with medial epipods; protopod II lateral epipods lobe-like. Pleopod I exopod broadest proximally, distal margin rounded, lateral margin rounded, dorsal surface lacking setae. Pleopod II endopod appendix masculina shaft proximal half ventral shape in cross section concave, not forming tube; basal musculature not pronounced (present but comparatively weak); distal tip broadly rounded; with 99 setae on margin (approximately), occurring laterally and medially; length 0.32 pleopod length, distal tip extending near to distal margin of endopod. *Uropod* (Figs. 1A, 2E–G) total length 1.14 pleotelson length. Protopod length 0.42 uropod total length; dorsomedial ridge produced, plate-like, margin smooth, margin setae robust and simple; with 2 robust spinose setae on distoventral margin, without robust simple setae on distoventral margin. Rami cross-sectional shape flattened on dorsal surface only. Endopod longer than

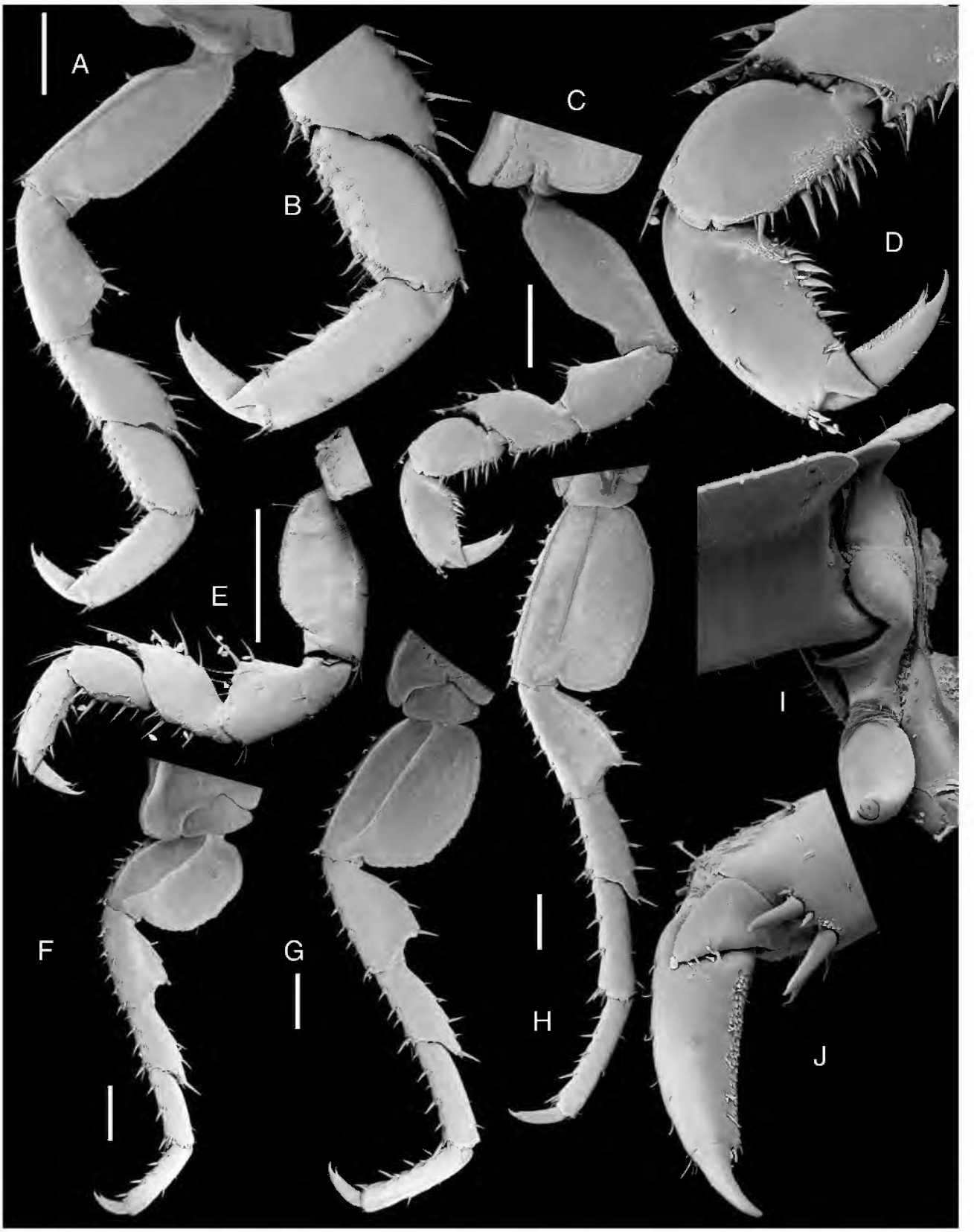

Figure 6. *Eremisopus beei* n.gen., n.sp. Paratype ♂ (AM P61454); paratype ♀ (AM P61455). A,B, ♂ pereopod II; C,D, ♂ pereopod IV; E, ♀ pereopod IV; F,G, ♂ pereopods V–VI; H–J, ♂ pereopod VII. Scale bar 1 mm.

protopod, straight-curving dorsally; dorsal margin robust setae placed midlength, 3–6 robust setae (3 laterally, 6 medially). Exopod length 0.84 endopod length; with 4 robust setae.

Sexual dimorphism, differences of female from male. *Antennula* with 12 articles. *Antenna* flagellum length 0.68 total antenna length, with 26 articles; proximal articles lacking dense cuticular hairs. *Pereopod I* dactylus

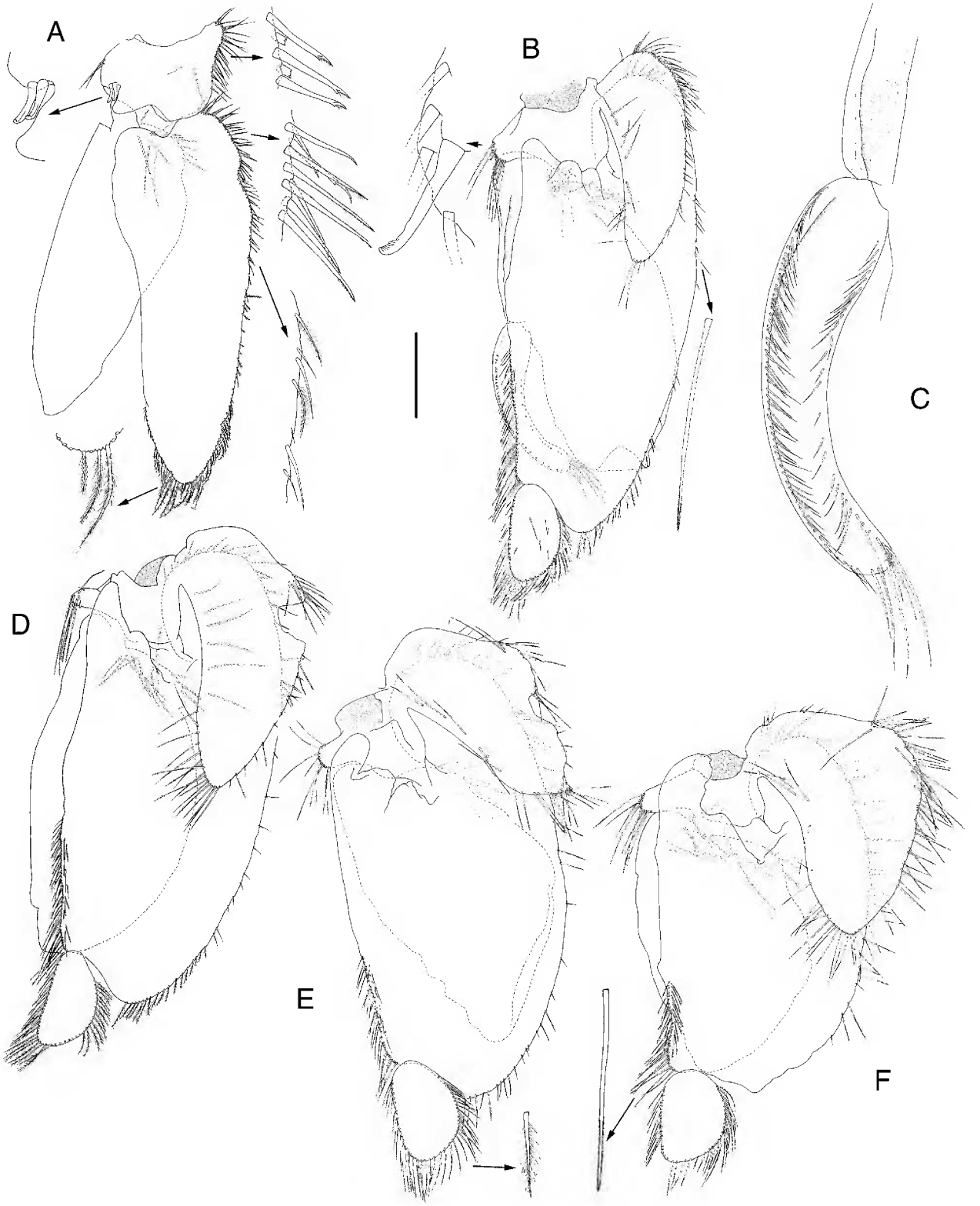

Figure 7. *Eremisopus beei* n.gen., n.sp. Paratype ♂ (AM P61456). A, pleopod I; B,C, pleopod II; D–F, pleopods III–V. Scale bar 1 mm.

ventrodistal margin with row of thin scale-like spines, along 0.56 total length; propodus dorsal margin proximal region not protruding beyond distodorsal margin of carpus. *Pereopod IV* propodus with 5 broad based setae on ventral margin. *Uropod* total length 0.96 pleotelson length; endopod with 2–7 robust setae (2 laterally, 7 medially); exopod length 0.86 endopod length, 3 robust setae.

Remarks. Some specimens of *Eremisopus beei* n.gen., n.sp. were reddish, owing to red pigments (possibly iron oxides) from the substrate adhering to their cuticle. Mr Cameron Bee brought numerous specimens back from a May 1997 field trip to the Kimberley. He kept his specimens in an aquarium for over a year with various native fishes. We also kept several specimens in a small unheated tank in our

laboratory from late May 1997 until January 1998. During this time, a brooding female released several young and moulted to a preparatory condition. Despite their limited distribution in the wild, these animals appear to tolerate a broad range of environmental conditions in the laboratory. In the aquaria, these animals were active and, when disturbed, swam using strong strokes of the pleopods and running motions of the anterior pereopods.

General distribution and habitat. "South Creek", near Kalumburu, Western Australia; fine sand and gravel, under rocks.

Peludo n.gen.

"New Genus 2": Wilson & Johnson, 1999: 265, fig. 1.
"New Genus X2": Wilson & Keable, 2001, table 1.

Type species. *Peludo paraliotus* n.sp.

Etymology. "*Peludo*" is a Spanish word meaning "hairy", suggested by the resemblance of this taxon to the furry donkey in Juan Ramón Jiménez's prose poem "Platero y Yo". The gender is interpreted to be masculine.

Diagnosis. External body surfaces covered with fine cuticular hairs, forming dense "fur", except for tuberculate dorsal midline. Head antennal notch deep, extending completely under eye; head length shorter than width in dorsal view, with several tubercles. Pleotelson strongly curled under body, pleopodal cavity facing anteriorly; posterior margin medial lobe reflexed against dorsal surface, triangular in posterior view; lateral lobes plate-like, shallower than basal width of uropod protopods; postanal ridge forming thin curved ring at edge of anal margin, lacking setae; dorsal uropod ridge elongate. Mandible palp length 0.4 mandible body length; article 1 forming thin ring, barely visible. Pereopodal dactyls proximally constricted, distally thin and sharp. Pleopod epipods without coupling hooks; exopods I–II strongly concave laterally. Uropod protopod dorsomedial plate broader than shaft, covering anus, lacking marginal setae.

Remarks. *Peludo* n.gen. is one of the more unusual taxa in the Amphisopodidae. Its reduced mandibular palp occurs nowhere else among the Phreatoicidea. The cuticular hairs, which cover the body, are usually seen only at high magnification and on scattered parts of the body in other phreatoicideans, examples include the basal part of the antennal flagellum in *Eremisopus* n.gen., and on the pleotelson (and elsewhere) in species of a new genus from the Grampians, Victoria (Wilson & Keable, in press). In *Peludo*, however, these hairs are macroscopic and dense. The deep antennal notch of *Peludo* extends well under the eye, giving it an almost pedunculate appearance (e.g., Fig. 8E); the eye of other phreatoicideans is more clearly fused to the head. The pleotelson of *Peludo* is so strongly curled under the body that it cannot be fully straightened, at least in preserved specimens, whereas most other phreatoicideans are capable of fully extending the pleon (pleonites and pleotelson). Figure 8B shows a live animal with the maximum extent of pleon extension. The pleotelson and uropods appear to close off the pleopodal and anal chambers (see Fig. 9A–C; the uropods in Fig. 9E,G,H were artificially spread to allow a ventral view of the pleotelson tip). The pleotelson distal tip of *Peludo*, flattened against the posterior surface of the pleotelson, superficially approximates the condition in *Platypyga* n.gen., although these two taxa have decidedly different forms of this structure. The pereopod I merus of *Peludo* overhangs from the carpus to the propodus, appearing longer than in other taxa such as *Crenisopus, Phreatoicus* Chilton, 1883 and *Crenoicus*.

Peludo paraliotus n.sp.

Figs. 8–14

Type material. HOLOTYPE ♂, WAM C 25051, bl (body length) 34.1 mm (formalin preserved). PARATYPES: formalin preserved—WAM C 25052, ♂ bl 24.3 mm, ♀ bl 19.3 mm, ♀ bl 16.6 mm; AM P60532, 11 ♂♂, 3 ♀♀, 12 indeterminate specimens; AM P61461, ♂ bl 26.1 mm (dissected for SEM); AM P61556, ♀ bl 19.6 mm (dissected for SEM); AM P61557, ♂ bl 28.9 mm (dissected for description and also illustration of pleopods); AM P61558, ♀ bl 22.3 mm (dissected for description and also illustration of pleopods); ethanol preserved—AM P60533, 26 ♂♂, 3 ♀♀, 14 indeterminate specimens—all from type locality, hand and hand sieves, pH 6.57, 11.8°C, G. Wilson, R. Wetzer & S. Keable, 6 September 1999, WA-597.

Type locality. Stream flowing from swamp at road crossing to le Grand Beach, Cape le Grand National Park, Western Australia, 33°58.75'S 122°07.23'E (GPS), under rocks and log, among base of reeds.

Other material. WAM C 21976 (WAM 28–95), ♂ bl 35.5 mm, Cape le Grand National Park, Western Australia, B. Knott, 20 May 1977; series from Cape le Grand National Park, Western Australia, G. Wilson, R. Wetzer & S. Keable, preserved in 95% ethanol—AM P60534, 19 ♂♂, 3 ♀♀, 65 indeterminate specimens, freshwater creek flowing into Hellfire Bay, 34°00.18'S 122°09.63'E (GPS), reed roots and rocks on edge of gully, sandy substrate (no mud), along steep side of gully 50–75 m from beach, hand sieves, pH 6.7, 17°C, 5 September 1999, WA-591; AM P60535, 1 ♂, 2 ♀♀, 1 indeterminate specimen, *Juncus* swamp/peat land behind Hellfire Bay, 33°59.99'S 122°09.72'E (GPS), silty wet substrate among roots of *Juncus*, hand sieves, 5 September 1999, WA-593; AM P60536, 2 ♂♂, 3 ♀♀, 7 indeterminate specimens, perennial *Juncus* swamp east of Hellfire Bay, 34°00.06'S 122°10.02'E (GPS), hand sieves, 6 September 1999, WA-596.

Etymology. The Greek species name "*paraliotus*" means "an inhabitant of the seacoast".

Diagnosis. See generic diagnosis.

Description based on male. *Colouration* in life, dark reddish brown, same colour as substrate. In 95% ethanol, dorsal surfaces of head, pereon and pleon grey mottled with pink, lateral surfaces of head, pereon and pleon, and dorsal surface of pleotelson, with dense "fur" of cuticular hairs trapping brown sediment, some pink cuticle exposed on pereopods. When cleaned, lateral surfaces and appendages mostly pink, mottled with grey.

Head (Fig. 8A,C–E) length shorter than width in dorsal view; width 0.78 pereonite 1 width; lateral profile of dorsal surface smoothly curved; setae absent. Eyes bulging dorsolaterally; maximum diameter 0.24 head depth; dorsal margin convex, ventral margin concave; orientation of longest axis horizontal; ocelli distinguishable as individual

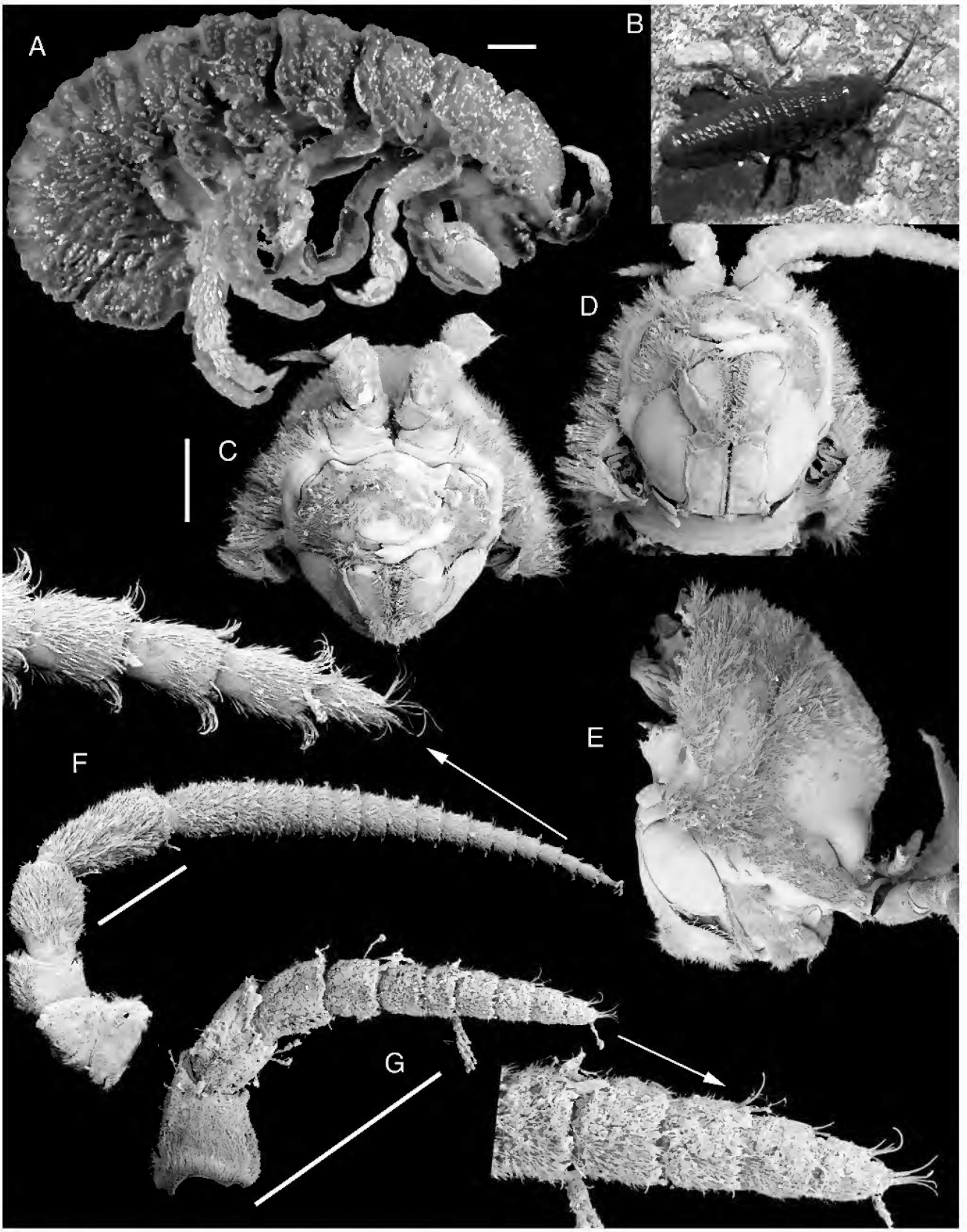

Figure 8. *Peludo paraliotus* n.gen., n.sp. A, holotype ♂ (WAM C 25051); B, living paratype at type locality (specimen among AM P60532/3); C–E, paratype ♀ (AM P61556); F,G, paratype ♂ (AM P61461). A, lateral view; B, dorsal view; C–E, head; F, antenna; G, antennula. Scale bar 1 mm.

units, pigmentation dark. Cervical groove smoothly curved, extending nearly to dorsal margin of head. Mandibular groove present. Mandibular notch present. Clypeal notch present. *Pereon* (Fig. 8A) broad, width exceeding head width; dorsal surface with scattered tubercles and with transverse ridges; setae on dorsal surface absent. Pereonites

Figure 9. *Peludo paraliotus* n.gen., n.sp. A–C,F, paratype ♂ (AM P61461); D,E,G,H, paratype ♀ (AM P61556). A–H, pleotelson and uropods. Scale bar 1 mm.

2–7 in dorsal view wider than long. Coxal articulation of pereonites 2–4 nearly fused, 5–7 free (although coxa 5 partially fused). Sternal process occurring on sternite 7 (more pronounced in female). Typhlosole absent, gut round in cross section; hindgut caecae absent. *Pleonites* (Fig. 9A–C) in dorsal view 2–4 respective lengths more than half the length of pleonite 5, 1–4 relative lengths unequal, pleonite 4 length greater than pleonites 1–3, 1–4 width 0.78 composite length in dorsal view. *Pleotelson* (Figs. 8A, 9) lateral length 0.12 body length, 0.66 depth; dorsal length 1.18 width; depth 1.23 pereonite 7 depth. Posterior margin entire, reflexed dorsally, without irregular denticulations; median lobe width 0.5 pleotelson width, produced, greatest length 0.05 pleotelson total length; lateral lobes forming vertical plates, narrower than median lobe, distinct from median lobe, extending beyond median lobe, medial length 0.1 pleotelson total length; median lobe robust sensillate setae absent; lateral lobes robust sensillate setae absent.

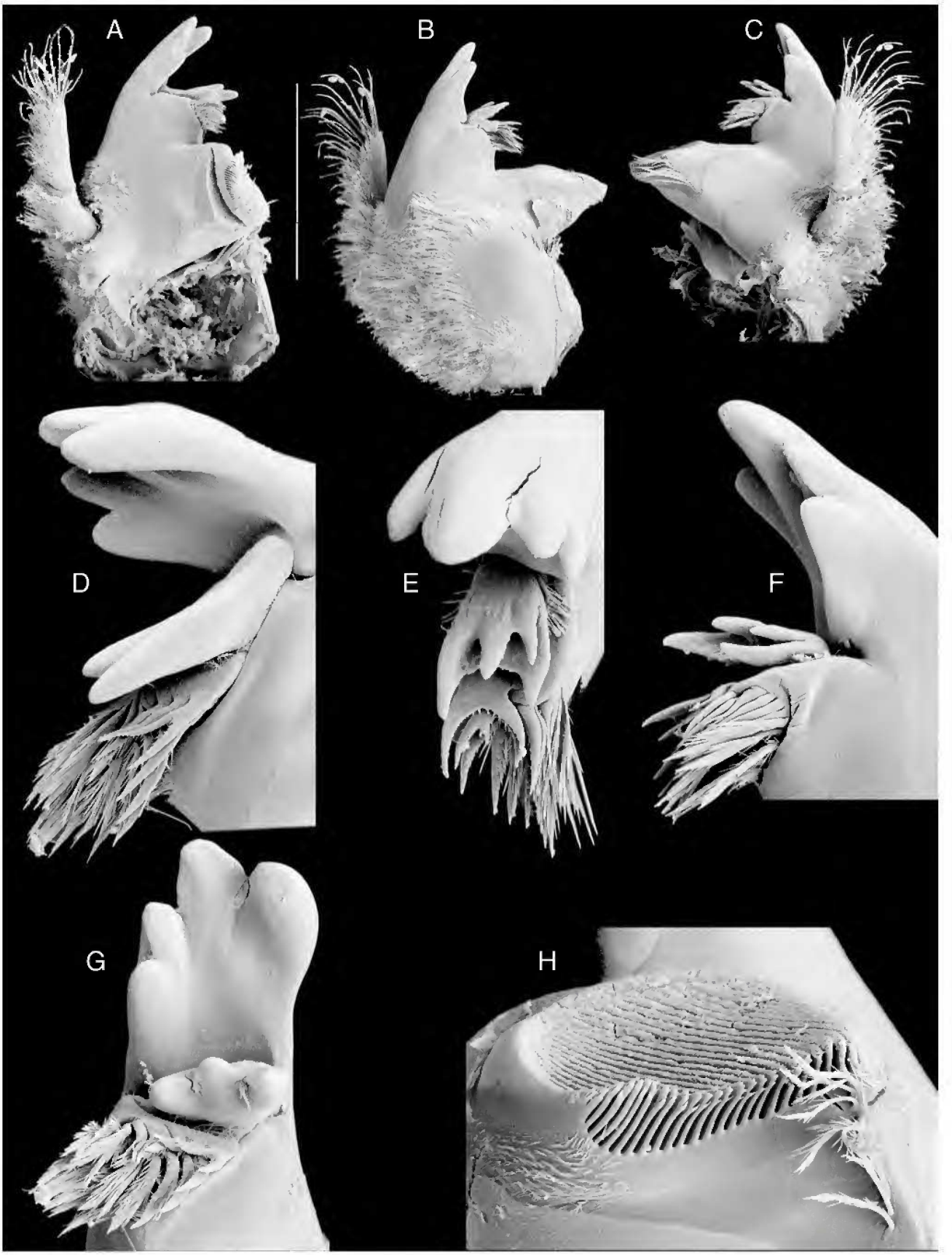

Figure 10. *Peludo paraliotus* n.gen., n.sp. Paratype ♂ (AM P61461). A,D,G,H, left mandible; B,C,E,F, right mandible. Scale bar 0.5 m.

Dorsal uropodal ridge without setae. Ventral margin anterior to uropods with robust setae, setae denticulate, 7 altogether, posterior seta subequal to anterior adjacent setae. *Antennula* (Fig. 8G) length 0.09 body length, with 12 articles. Tiny aesthetascs on article 7 to terminal article. Terminal article distally oblique, with 2 or more groups of aesthetascs (tiny).

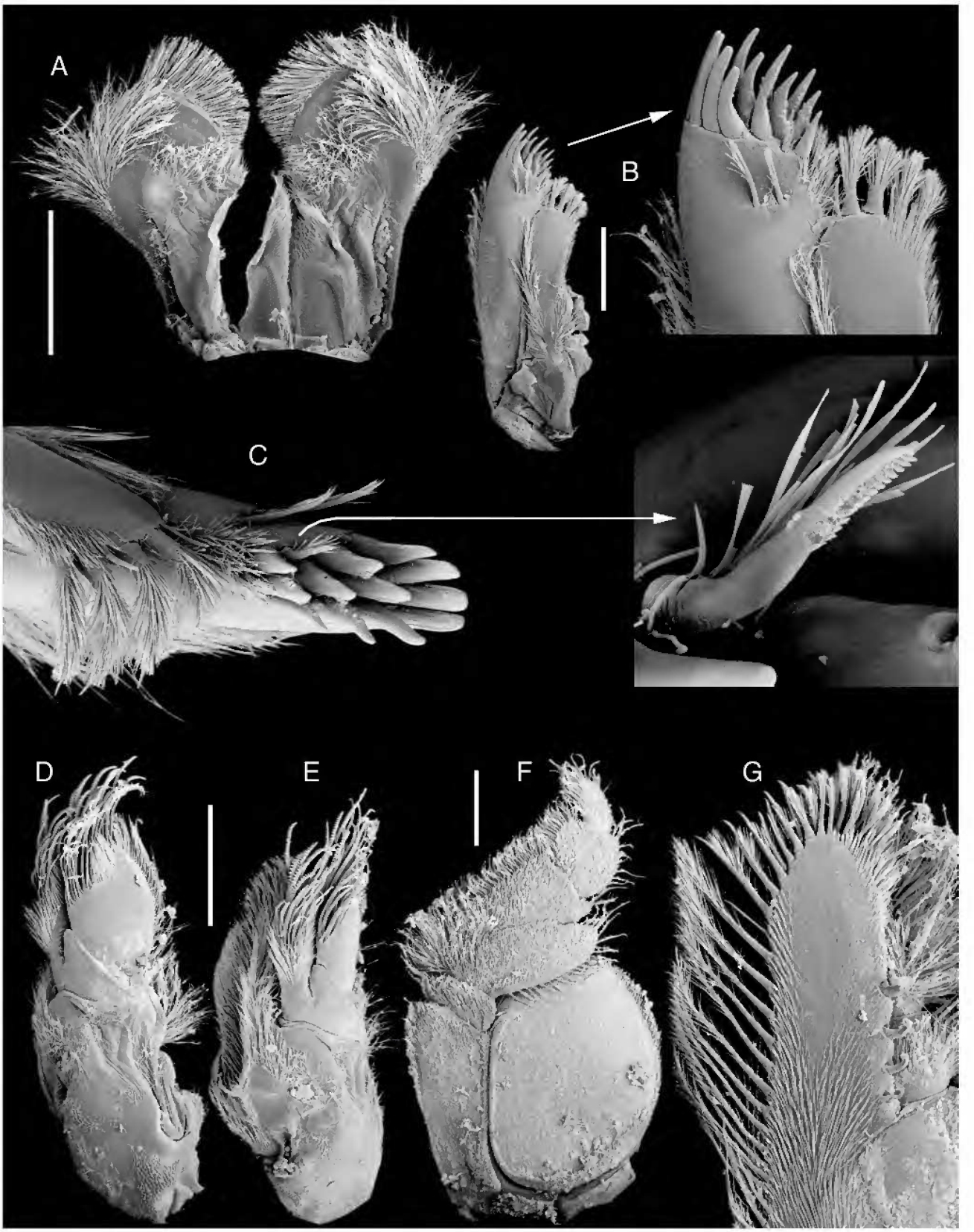

Figure 11. *Peludo paraliotus* n.gen., n.sp. Paratype ♂ (AM P61461). A, paragnaths; B,C, maxillula; D,E, maxilla; F,G, maxilliped. Scale bar 0.5 mm.

Penultimate article length approximately subequal to length of other articles. Distal articles circular. *Antenna* (Fig. 8F) length 0.26 body length. Flagellum length 0.59 total antenna length, with 20 articles. Propodal article 1 absent. Article 5 shorter than article 4, article 6 shorter than articles 4 and 5 combined. *Mouthfield* (Fig. 8C,D) clypeus consisting of

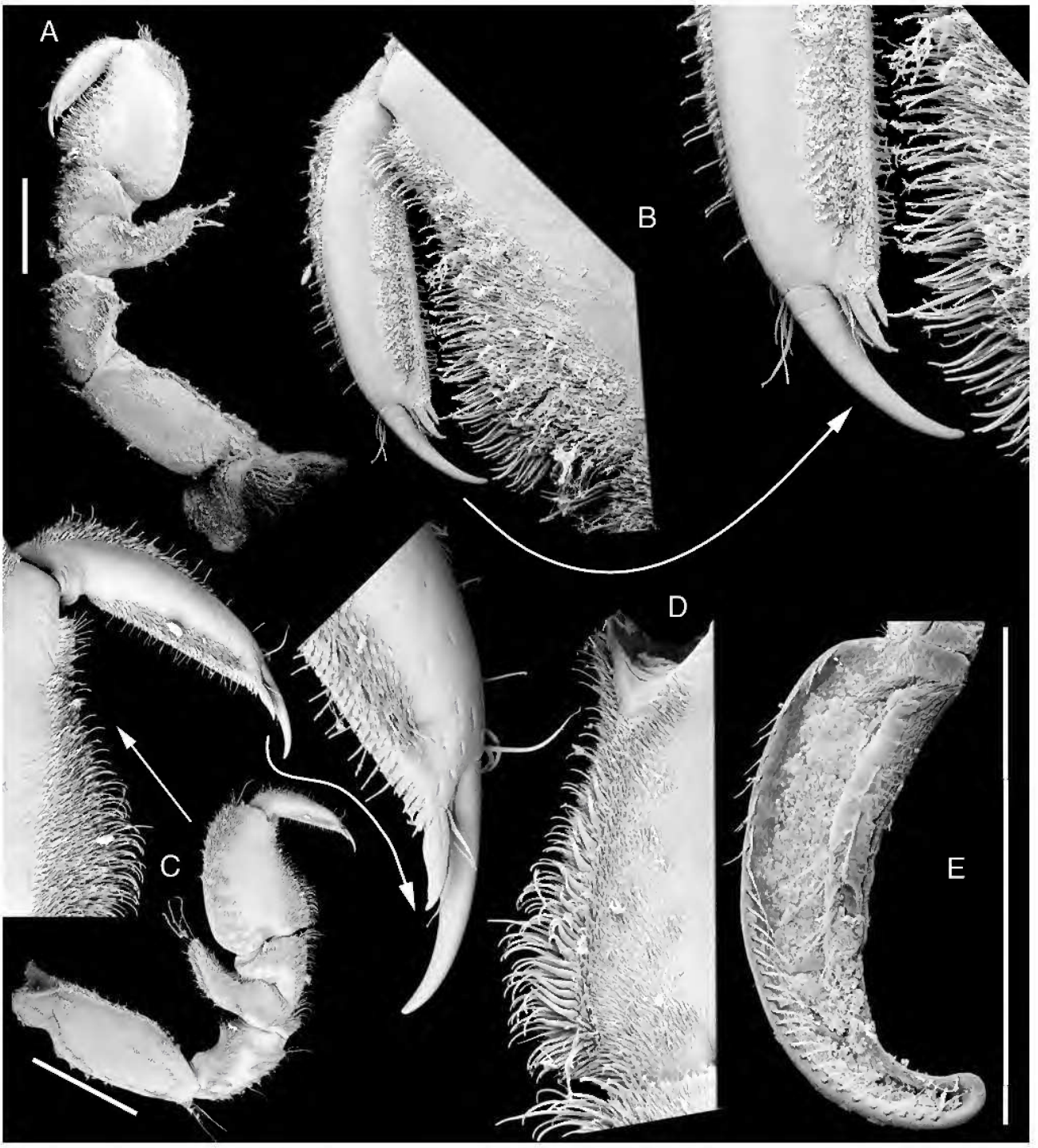

Figure 12. *Peludo paraliotus* n.gen., n.sp. Paratype ♂ (AM P61461); paratype ♀ (AM P61556). A,B, ♂ pereopod I; C,D, ♀ pereopod I; E, ♂ pleopod II appendix masculina. Scale bar 1 mm.

broad bar rounded at mandibular fossae, width 0.56 head width. Labrum ventrally semicircular in anterior view, asymmetrical, broadest on right side. Paragnaths (Fig. 11A) with distolaterally rounded lobes, having medial and lateral setal rows and thickened medial base covered with cuticular spinules. *Mandible* (Fig. 10) left spine row with 16 spines (approximately), 6 of which are bifurcate. Right spine row with 14 spines (approximately), 5 of which are bifurcate. Molar process with 1 tooth, complex setulate setae forming posterior row (plumose). *Maxillula* (Fig. 11B,C) medial lobe length 0.85 lateral lobe length; width 0.7 lateral lobe width; with 4 pappose setae; with 2 "accessory" setae, one on distolateral margin and one between central pappose setae, "accessory" setae simple; short weakly setulate seta on distal tip absent. Lateral lobe distal margin with 7 denticulate robust setae, with 6 smooth robust setae; ventral face with 2 plumose setae. *Maxilla* (Fig. 11D,E) medial lobe width 0.78 outer lateral lobe width; proximal portion smoothly continuous with distal portion; proximal and distal setal rows continuous. Outer lateral lobe length subequal to inner lateral lobe, wider than inner lateral lobe. *Maxilliped* (Fig. 11F,G) epipod distal tip pointed. Endite medial margin with

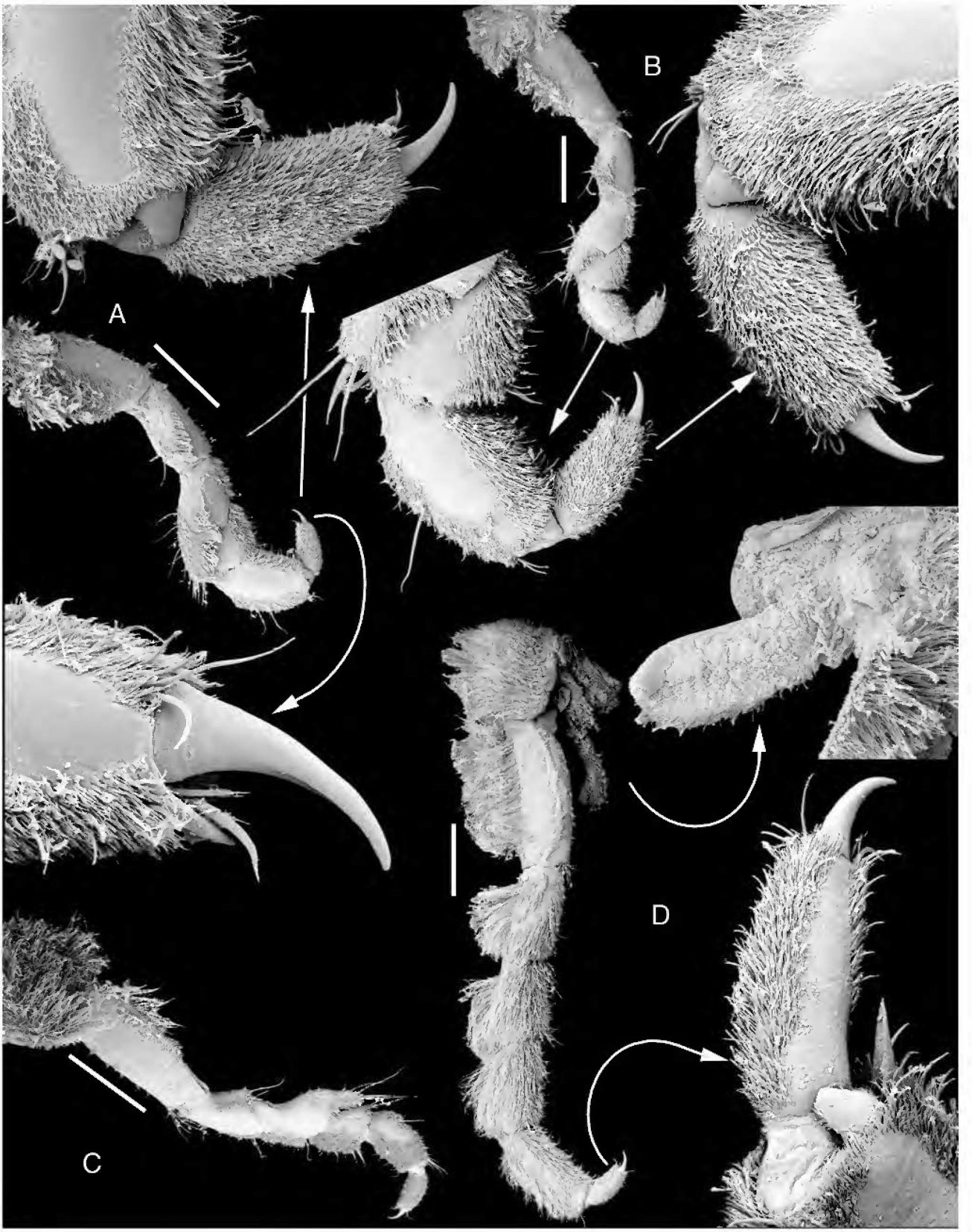

Figure 13. *Peludo paraliotus* n.gen., n.sp. Paratype ♂ (AM P61461); paratype ♀ (AM P61556). A, ♂ pereopod II; B, ♂ pereopod IV; C, ♀ pereopod IV; D, ♂ pereopod VII, with penes and articular plate. Scale bar 1 mm.

4 coupling hooks on left side, 4 on right side; dorsal ridge with 26 large distally denticulate plumose setae (but only distal setae denticulate). *Pereopod I* (Fig. 12A–D) dactylus length subequal to palm; ventrodistal margin smooth; with 2 distal accessory claws; distal accessory spines absent. Propodus dorsal margin proximal region not protruding. Propodal palm concave, spine-like projections absent; cuticular fringe weakly developed; stout denticulate setae

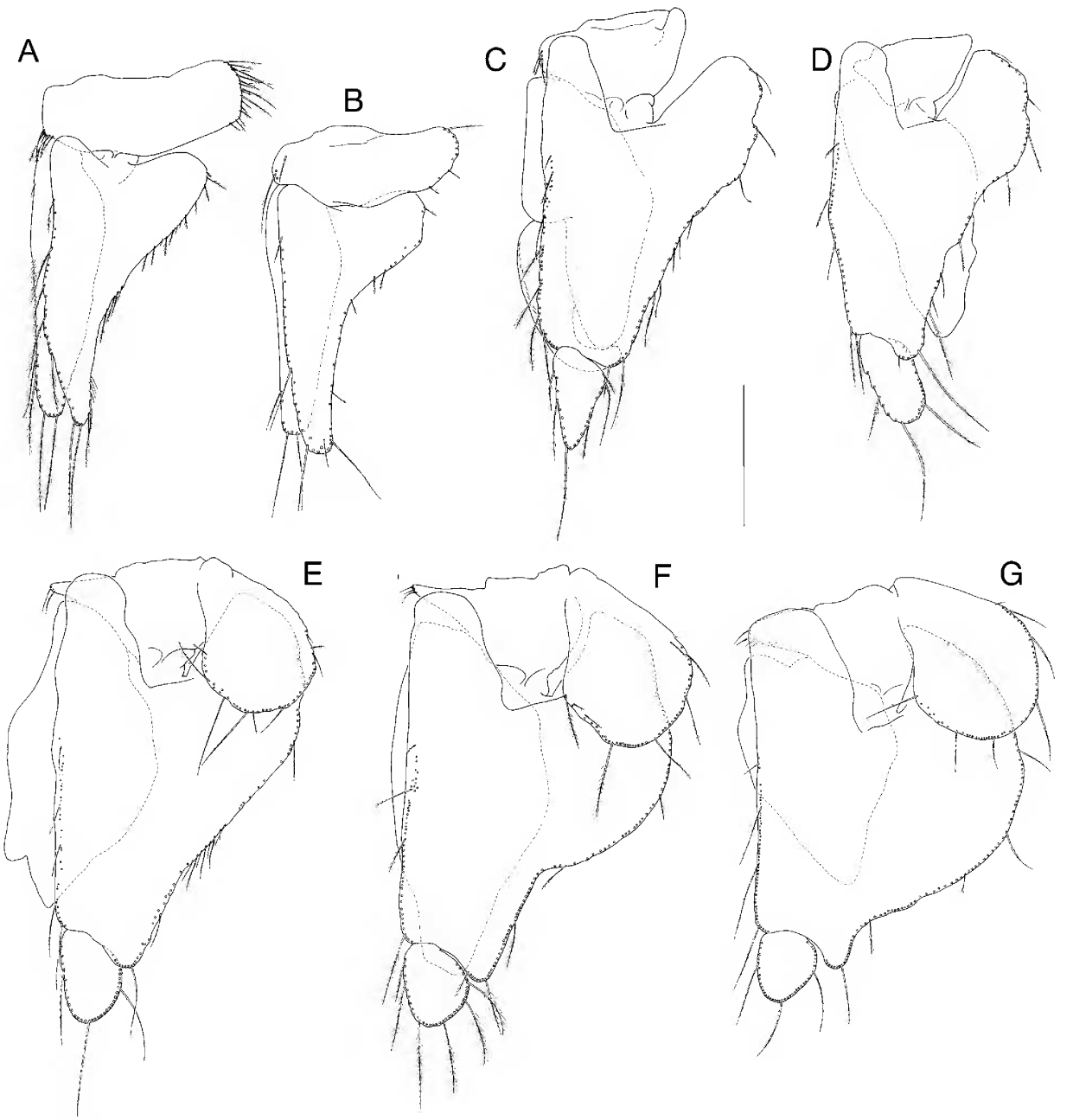

Figure 14. *Peludo paraliotus* n.gen., n.sp. A,C,E–G, paratype ♂ (AM P61557); B,D, paratype ♀ (AM P61558). A,B, pleopod I; C,D, pleopod II; E–G, pleopods III–V. Scale bar 1 mm.

absent; stout robust simple setae conical, 19 altogether; with 20 elongate broad based setae. Merus dorsal margin projection shelf-like and U-shaped (but approaching a spine-like condition), with numerous elongate simple setae. *Pereopods II–III* (Fig. 13A) dactylus without spines on ventral margin; with 1 distal accessory claw. Propodus articular plate present. Basis dorsal ridge in cross section produced and forming distinct plate. *Pereopod IV* (Fig. 13B,C) simple, not prehensile. Dactylus length subequal to propodal palm. Propodus with 12 broad based setae on ventral margin, 1 distinctly larger than others; shorter than dactylar claw. Basis dorsal ridge in cross section angular and produced but not forming distinct plate. *Pereopods V–VII* (Fig. 13D) dactylus with 1 distal accessory claw; spines absent. Propodus articular plate on posterior side of limb present. Basis dorsal ridge distinctly separated from basis shaft, in cross section produced and forming distinct plate. Pereopod VII ischium dorsal ridge forming flange less than shaft width. *Penes* (Fig. 13D) curved posteriorly; length 0.23 body width at pereonite 7, extending past midline and onto pleonite 1; with cuticular hairs on shaft, distally tapering and broadening (broadest medially); distal tip flattened and truncate. *Pleopod* (Figs. 9C,F, 12E, 14) exopods with lateral proximal lobes on I–V (extending laterally but not extending proximally along protopod on pleopod I), medial proximal lobes on I–V (just extending on to protopod on pleopod I). Endopod I only with setae on margins, setae plumose. Protopods II–V with medial epipods; protopod I lateral epipods linear. Pleopod I exopod broadest proximally, distal margin rounded, dorsal surface lacking setae. Pleopod II endopod appendix masculina shaft proximal half ventral shape in cross section concave, not

forming tube; basal musculature pronounced; distal tip broadly rounded; with 51 setae on margin, occurring laterally and medially; length 0.68 pleopod length, distal tip extending near to distal margin of endopod. *Uropod* (Fig. 9) total length 0.97 pleotelson length. Protopod length 0.53 uropod total length; dorsomedial ridge produced, plate-like, margin smooth; dorsolateral margin setae absent; distoventral margin robust setae absent; ventral ridge without rows of long laterally projecting setae (implicit character state: abundant long "cuticular hairs" present). Rami distal tips pointed; cross-sectional shape round. Endopod longer than protopod, straight-curving dorsally; dorsal margin robust setae absent. Exopod length 0.87 endopod length; exopod dorsal margin robust setae absent.

Sexual dimorphism, female differences from male. *Antennula* with 11 articles. *Antenna* length 0.31 body length. *Pereopod I* dactylus ventrodistal margin with row of thin scale-like spines, along 0.44 total length; propodal palm with 23 elongate broad based setae. *Pereopod IV* propodus with 9 broad based setae on ventral margin. *Uropod* total length 1.1 pleotelson length, protopod length 0.55 uropod total length.

Remarks. The Hellfire Bay specimens (samples WA591–593) are not obviously different from those from the type locality. The largest specimens, however, are significantly smaller than those collected near Cape le Grand Beach. Nevertheless, all of our collections of this species from Cape le Grand National Park appear to be conspecific.

General distribution and habitat. Cape le Grand National Park, Western Australia; silty coastal wetlands including *Juncus* swamps and outflowing streams.

Platypyga n.gen.

"New Genus 4" Wilson & Johnson, 1999: 265, fig. 1.
"New Genus X4" Wilson & Keable, 2001, table 1.

Type species. *Platypyga subpetrae* n.sp.

Etymology. "*Platypyga*" is derived from the Greek words meaning "flat rump", which refers to the flattened posterior margin of the pleotelson.

Diagnosis. Body dorsal surfaces pitted especially on head, lacking elongate setae. Head lacking cervical groove. Pleotelson posterior margin with broad reflexed medial region, compressed toward anterior and dorsal margins, medially cleft, forming curved ridge between widely-separated dorsal projections, each with large robust setae; postanal ridge narrow, with fine setae. Pereopods V–VII with dorsal ridge plates narrower than basis shaft. Pleopod I protopod with coupling hooks. Uropod protopod ventral ridge with rows of laterally projecting long simple setae; dorsomedial plate absent; distoventral robust setae lacking denticles. Uropod rami distally rounded, with apical elongate robust setae.

Remarks. We homologise the unusual pleotelson posterior margin of *Platypyga* n.gen. with the cleft medial lobe found in *Synamphisopus* and *Phreatomerus*. Although we are uncertain, assuming that the two widely spread lobes are homologous to the medial lobe of the other taxa appears to be the simplest explanation. Thus, the small setose bumps on lateral margin just above the uropodal insertions may be homologous with the lateral lobes of other taxa. The posterior margin in *Platypyga*, however, lacks any definite demarcation between the larger, more dorsal lobes and this group of setae. Other taxa have groups of setae above the uropods, complicating this interpretation. Because of this uncertainty, we have not scored *Platypyga* as having lateral lobes. If, however, the dorsolateral pleotelson lobes of *Platypyga* are homologous with lateral lobes, phylogenetic analysis (research in progress) might place this taxon among the Phreatoicidae, despite its lacking phreatoicid mandibular (pedunculate spine row, absent right lacinia mobilis) and appendix masculina (generally rod-like) synapomorphies. This placement occurs because, unlike many amphisopodids, *Platypyga* also lacks a large dorsomedial plate on the uropodal protopod. The generalised appendix masculina of *Platypyga* (concave in proximal cross section, acutely rounded distally with a fringe of setae) is similar to other amphisopodids such as *Eremisopus* and *Peludo*, and may represent a plesiomorphic condition for the suborder. Consequently, *Platypyga* appears to have has a unique mixture of plesiomorphic and apomorphic features.

Platypyga subpetrae n.sp.

Figs. 15–22

Type material. HOLOTYPE ♂, WAM C 25053, bl 15.7 mm (ethanol preserved) hand sieve, G.D.F. Wilson, 8 October 1998, WA-564. PARATYPES: formalin preserved—AM P60537, 53 ♂♂, 1 indeterminate specimen, as for holotype except, 34°23.4'S 118°03.1'E, spring fed stream at base of scree slope, in silty gravel in pool on stream, hand sieves, pH 6.96, 11.0°C, G. Wilson, R. Wetzer & S. Keable, 9 September 1999, WA-603; AM P61460, ♂ 15.8 mm (dissected for SEM), collection details as for AM P60537; WAM C 25054, ♂ bl 18.2 mm, ♂ bl 14.3 mm, ♂ bl 13.9 mm, collection details as for AM P60537; ethanol preserved—AM P60538, 49 ♂♂, 5 ♀♀, same collection details as holotype; AM P61457, ♂ (dissected for SEM), same collection details as holotype; AM P61458, ♀ 7.4 mm (dissected for description, SEM and illustration of pleopods), same collection details as holotype; AM P61459, ♂ 13.7 mm (dissected for description and also illustration of pleopods), same collection details as holotype; AM P61559, 1 specimen (whole mounted for SEM), same collection details as holotype; AM P60539, 49 ♂♂, collection details as for AM P60537.

Type locality. Spring below Toolbrunup Peak, Western Australia, Australia, 34°23.41'S 118°02.98'E (GPS), 700m altitude, under rocks in sandy gravel, spring emerging at bottom of large scree slope.

Other material. WAM C 23271, ♂ bl 20 mm, Toolbrunup Peak, Stirling Range, Western Australia, 34°23.17'S 118°02.51'E, 1030m altitude (original data indicating Toolbrunup summit), from a southeast facing gully, S. Barrett, Department of Conservation and Land Management (CALM), 1996; AM P60540, 9 ♂♂, 5 ♀♀, 1 indeterminate specimen, spring in saddle on west side at head of stream running on south side of track, Bluff Knoll, Stirling Range, Western Australia, 34°22'S 118°15'E (map estimate), W.F. Ponder, January 1988.

Etymology. The species name "*subpetrae*" is a Latin genitive singular noun meaning "under a crag or pile of rocks", referring to the type locality at the base of a scree slope.

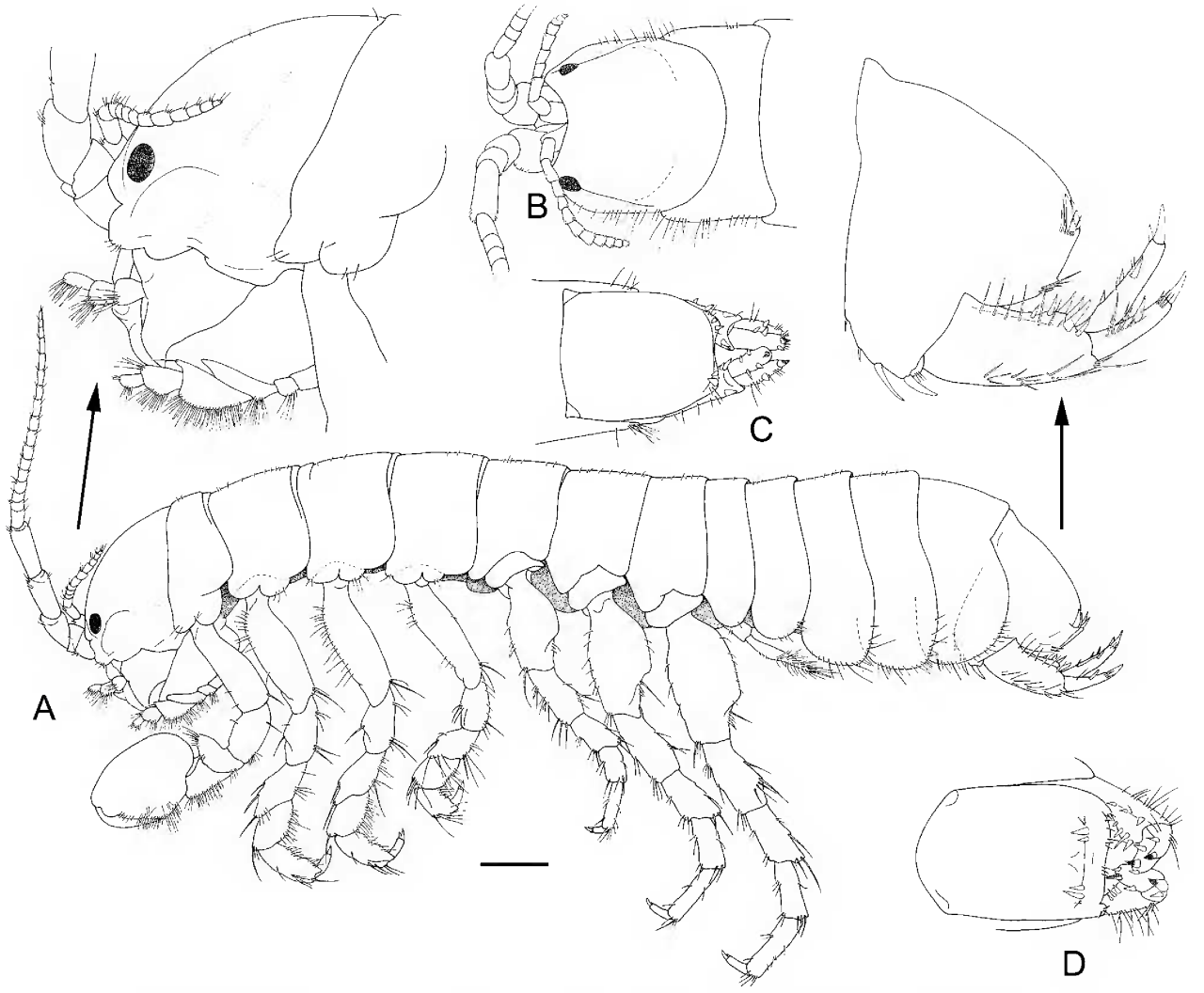

Figure 15. *Platypyga subpetrae* n.gen., n.sp. Holotype (WAM C 25053). A, lateral view with enlargements of head and pleotelson; B, head, dorsal view; C,D, pleotelson, dorsal and posterior views. Scale bar 1 mm.

Diagnosis. See generic diagnosis.

Description based on male. *Colouration* colourless in life, colour variable in specimens preserved in 95% ethanol—from slate grey-brown mottled with white to almost pure white with only slight brown-yellow tinges, gut a translucent turquoise visible through cuticle and particularly through sternites.

Head (Figs. 15A,B, 16A–C,E) length shorter than width in dorsal view; width 0.89–0.92 pereonite 1 width; lateral profile of dorsal surface smoothly curved; surface smooth and shiny; setae sparse, fine. Eyes bulging dorsolaterally (slight, the eye appears somewhat raised because of the strongly developed mandibular groove underneath it); maximum diameter 0.12–0.2 head depth; oval; orientation of longest axis vertical; ocelli not distinguishable as individual units, pigmentation dark and light (white background with variable black spots). Mandibular groove with acute indentation. Mandibular notch present. Clypeal notch present (weak). Antennal notch shallow, without posterior extension. *Pereon* (Figs. 15A, 16A) narrow, width near head width; dorsal surface with scattered roughness and smooth; setae on dorsal surface scattered, fine. Pereonites 2–7 in dorsal view wider than long. Coxal articulation of pereonites 2–4 nearly fused (lateral suture weak but complete), 5–7 free. Sternal processes absent. Typhlosole absent, gut round in cross section; hindgut caecae absent. *Pleonites* (Figs. 15A, 16A) in dorsal view 2–4 respective lengths more than half the length of pleonite 5, 1–4 relative lengths subequal, 1–4 width 0.85 composite length in dorsal view. *Pleotelson* (Figs. 15A,C,D, 21A–C) lateral length 0.11 body length, 0.94 depth; dorsal length 1.2 width; depth 1.48 pereonite 7 depth. Posterior margin without irregular denticulations; median lobe width 0.69 pleotelson width, greatest length 0.05 pleotelson total length; lateral lobes absent; median lobe with 2 robust sensillate setae on one of the cleft pair. Dorsal uropodal ridge terminating at pleotelson margin above uropods (implicit character state: short, weak); without setae. Ventral margin anterior to uropods with robust setae, setae smooth, 3 altogether, posterior seta smaller than anterior adjacent setae (thicker but shorter). *Antennula* (Fig. 16C,D) length 0.11 body length, with 12 articles. Tiny aesthetascs on articles 9, 11, 12. Terminal article distally oblique, with 2 or more groups of aesthetascs, length subequal to penultimate article length. Penultimate article length approximately subequal to length of other articles. Distal articles circular. *Antenna* (Figs. 15A, 16A,E–G) length 0.37 body length. Flagellum

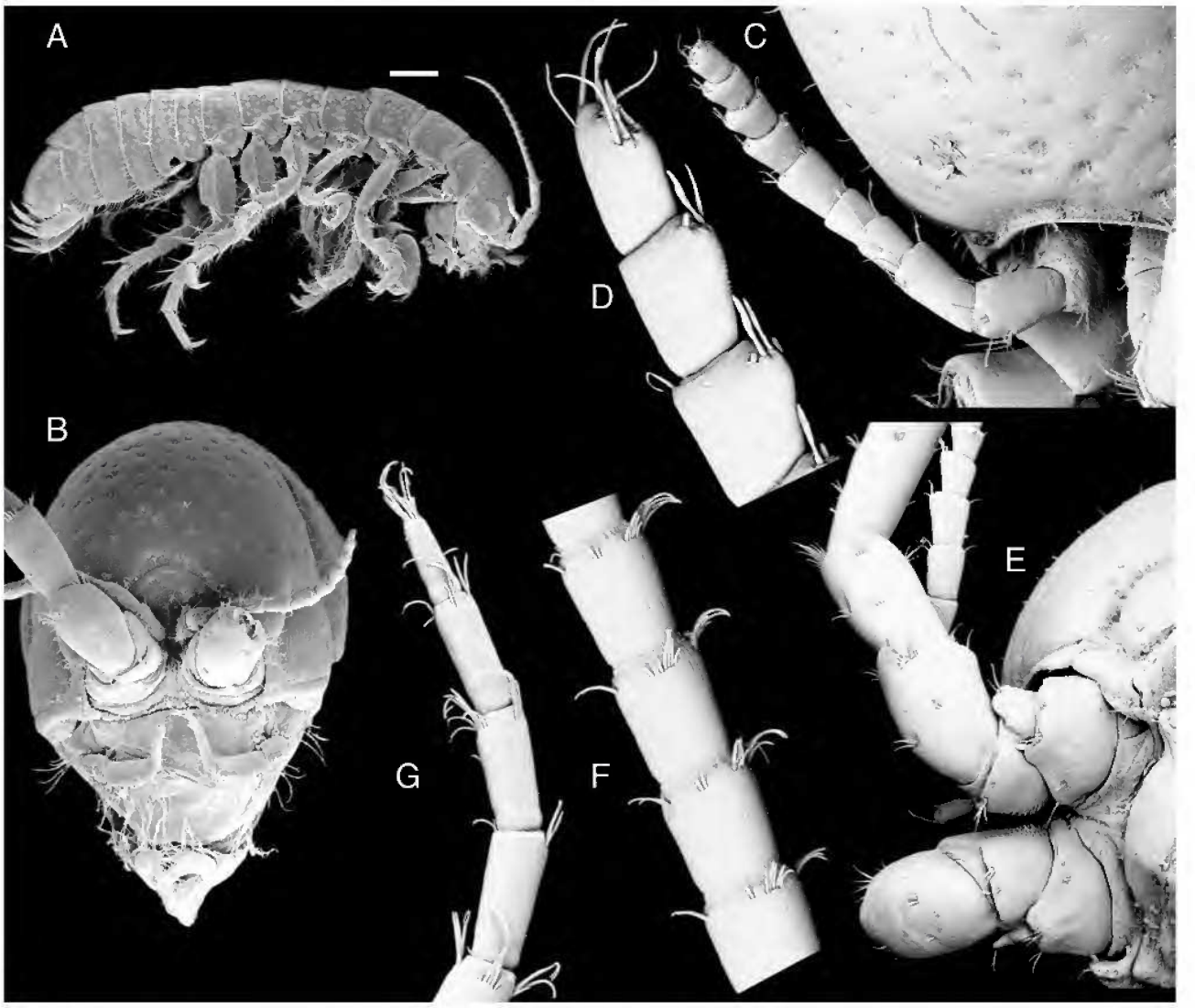

Figure 16. *Platypyga subpetrae* n.gen., n.sp. A,B, paratype (AM P61559); C–E, paratype ♂ (AM P61457). A, body lateral view; B,C,E, head; D, antennula, distal articles; F, antenna proximal flagellar articles; G, antenna terminal flagellar articles. Scale bar 1 mm.

length 0.62 total antenna length, with 18 articles. Propodal article 1 absent. Article 5 longer than article 4, article 6 shorter than articles 4 and 5 combined. *Mouthfield* (Figs. 15A, 16B) clypeus consisting of broad bar rounded at mandibular fossae, somewhat asymmetrical, broader on left side and with concave lateral margin, width 0.53 head width. Labrum ventrally semicircular in anterior view, somewhat asymmetrical. Paragnaths (Fig. 18A) with distolaterally rounded lobes, having medial and lateral setal rows and thickened medial base covered with cuticular spinules. *Mandible* (Fig. 17) palp length 0.64 mandible length. Left spine row with 12 spines, 9 of which are bifurcate. Right spine row with 14 spines, 9 of which are bifurcate. Molar process length subequal to width; with 1 tooth. *Maxillula* (Fig. 18B,C) medial lobe length 0.82 lateral lobe length; width 0.68 lateral lobe width; with 4 pappose setae; with 2 "accessory" setae, one on distolateral margin and one between central pappose setae, "accessory" setae simple; short weakly setulate seta on distal tip absent. Lateral lobe distal margin with 9 denticulate robust setae, with 5 smooth robust setae; ventral face with 2 plumose setae. *Maxilla* (Fig. 18D,E) medial lobe width 1.4 outer lateral lobe width; proximal portion distinctly angled to distal portion; proximal and distal setal rows continuous. Outer lateral lobe length subequal to inner lateral lobe, wider than inner lateral lobe. *Maxilliped* (Fig. 18F,G) epipod distal tip truncate. Endite medial margin with 5 coupling hooks on left side, 4 on right side; dorsal ridge with 17 large distally denticulate plumose setae (approximately, very weakly denticulate distally). *Pereopod I* (Fig. 19A–D) dactylus length subequal to palm; ventrodistal margin with row of thin scale-like spines, along 0.46 total length; with 1 distal accessory claw; distal accessory spines absent. Propodus dorsal margin proximal region protruding beyond distodorsal margin of carpus. Propodal palm convex to straight, spine-like projections absent; cuticular fringe weakly developed; stout denticulate setae absent; stout robust simple setae basally inflated, 8 altogether (SEM); with 6 elongate broad based setae. Merus dorsal margin projection shelf-like and U-shaped, with numerous elongate simple setae and with 1 or 2 robust simple setae. *Pereopods II–III* (Fig. 20A,B) dactylus without spines on ventral margin; with 1 distal accessory claw. Propodus articular plate present. Basis dorsal ridge in cross section angular and produced but not forming distinct plate.

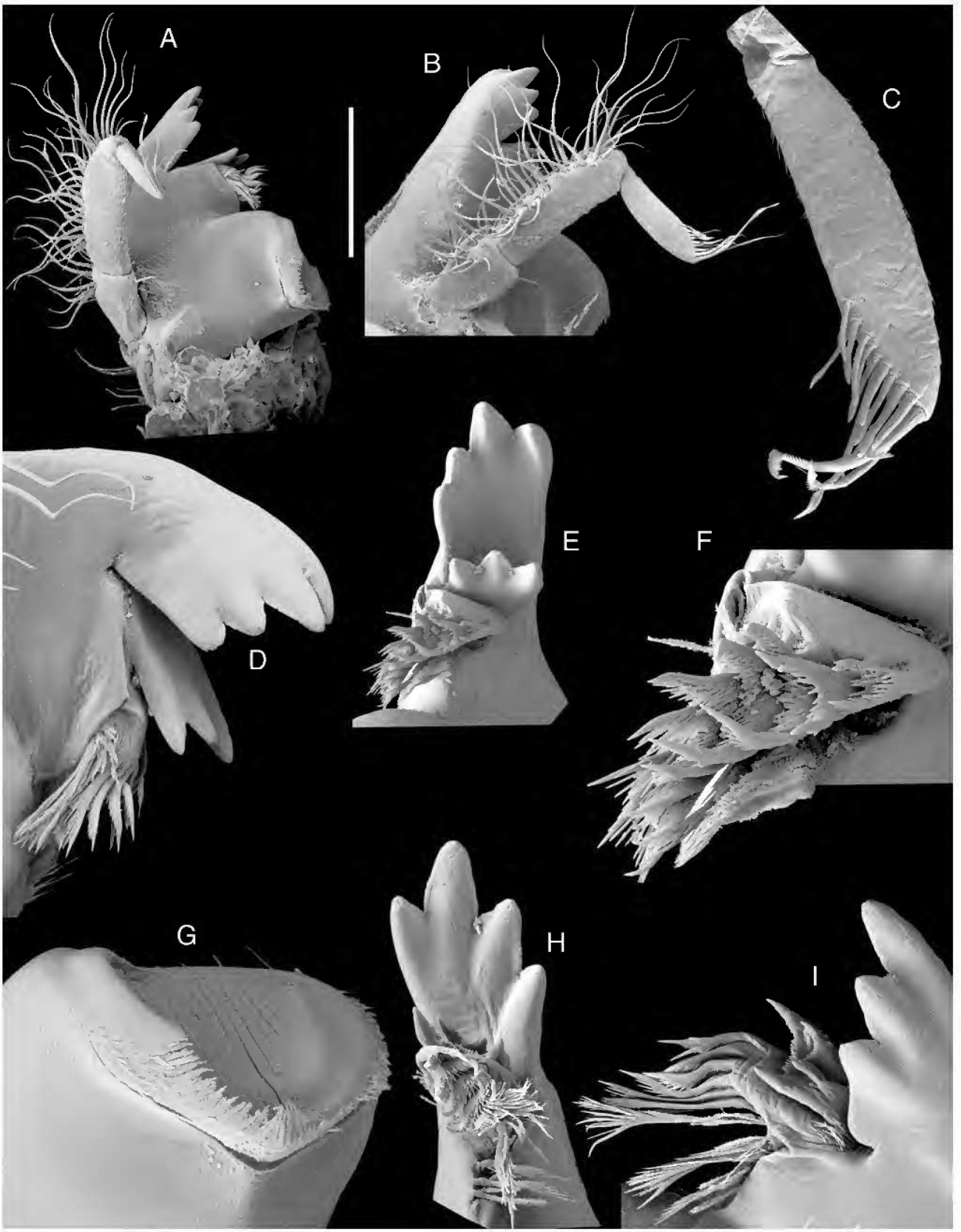

Figure 17. *Platypyga subpetrae* n.gen., n.sp. Paratype ♂ (AM P61460). A–G, right mandible; H,I, left mandible. Scale bar 0.5 mm.

Pereopod IV (Fig. 19E,F) subchelate with major hinges on dactylus-propodus (weakly). Dactylus shorter than propodal palm, or longer than propodal palm (shorter when measured on specimen, longer in SEM). Propodus with 1 broad based seta on ventral margin, shorter than dactylar claw (shorter when measured on specimen, subequal in SEM). Basis dorsal ridge in cross section angular and produced but not forming distinct plate. *Pereopods V–VII* (Fig. 20C–F)

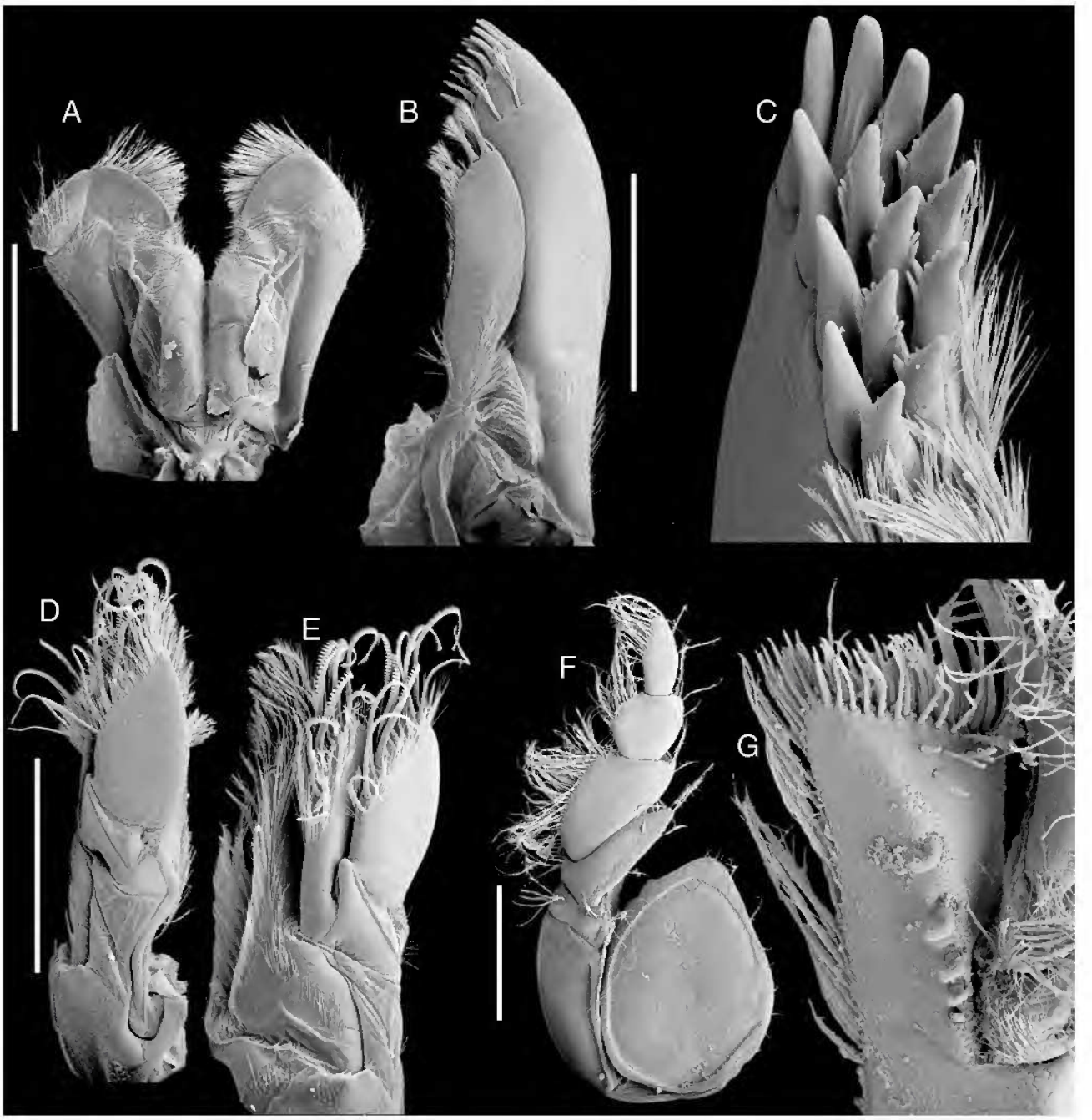

Figure 18. *Platypyga subpetrae* n.gen., n.sp. Paratype ♂ (AM P61460) A–E; paratype ♂ (AM P61457) F,G. A, paragnaths; B,C, maxillula; D,E, maxilla; F,G, maxilliped. Scale bar 0.5 mm.

dactylus with 1 distal accessory claw; spines absent. Propodus articular plate on posterior side of limb present. Basis dorsal ridge not distinctly separated from basis shaft, in cross section angular on pereopod V, produced and forming distinct plate on pereopods VI–VII. Pereopod VII ischium dorsal ridge flange absent. *Penes* (Fig. 20E) curved posteriorly; length 0.19 body width at pereonite 7, extending past midline and onto pleonite 1; smooth, lacking setae, distally tapering (broadest medially); distal tip rounded. *Pleopod* (Figs. 21E,F, 22) exopods lateral proximal lobes on II–V, medial proximal lobes on II–V. Endopods I–V without setae on margins. Protopods II–V with small medial projections, III–V with lateral epipods; 3–4 coupling hooks on I; lateral margin I with simple and lightly plumose setae, lateral margin II without setae, lateral epipods III–V with simple and lightly plumose setae; medial margin I without slender setae, medial margin/epipods II–V with simple setae. Pleopod I exopod broadest proximally, distal margin rounded, lateral margin rounded, dorsal surface lacking setae. Pleopod II endopod appendix masculina shaft proximal half ventral shape in cross section concave, not forming tube; basal musculature pronounced; distal tip acutely rounded; with 31 setae on margin, occurring laterally and medially; length 0.5 pleopod length, distal tip extending near to distal margin of endopod. *Uropod* (Fig. 21B–D) total length 1.21 pleotelson length. Protopod length 0.51 uropod total length; dorsomedial ridge not produced, margin setae robust and simple; with 1 robust simple seta on distoventral margin. Rami cross-sectional shape flattened on dorsal surface only. Endopod subequal to protopod

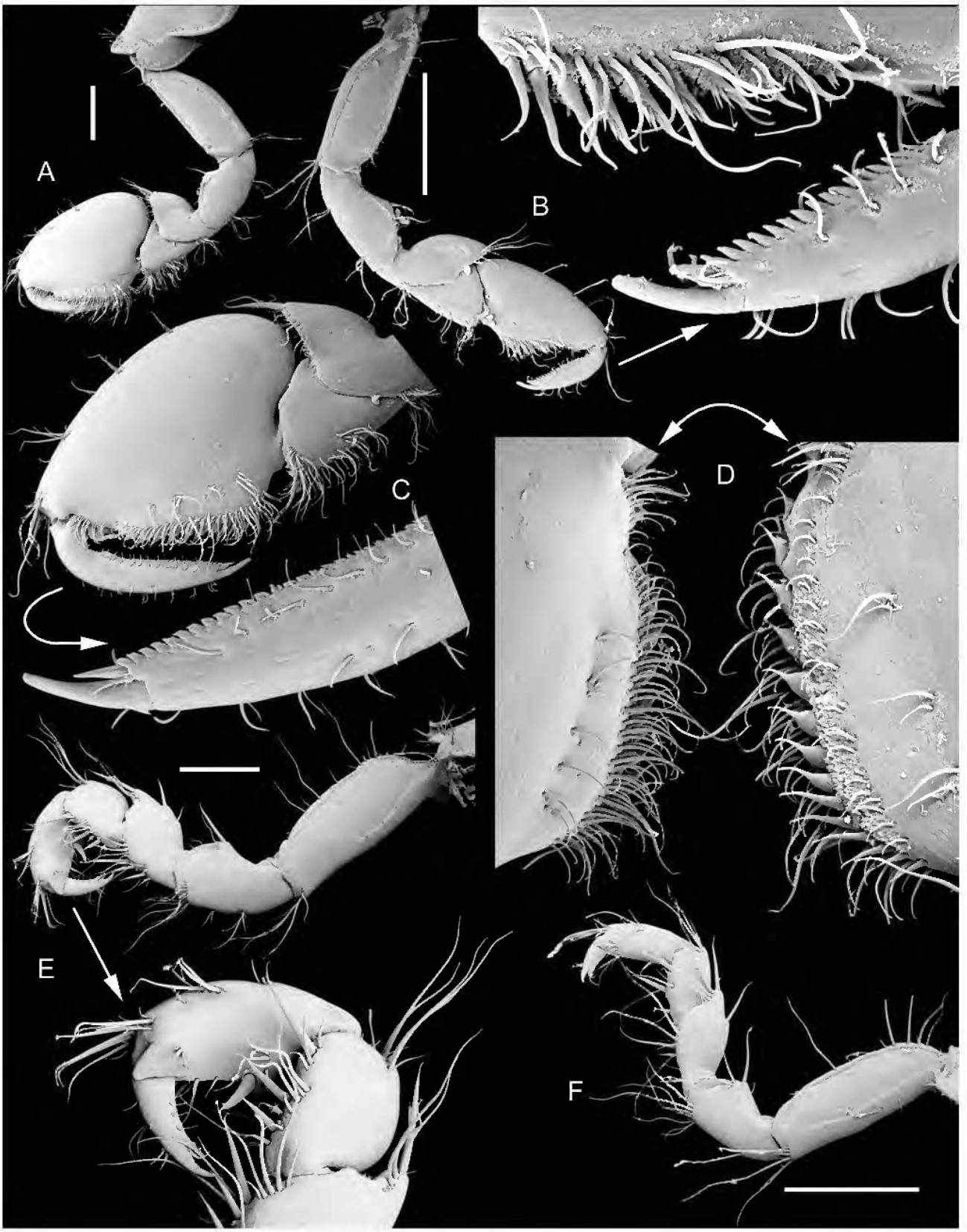

Figure 19. *Platypyga subpetrae* n.gen., n.sp. A,E, paratype ♂ (AM P61457); B,F, paratype ♀ (AM P61458); C,D, paratype ♂ (AM P61460). A, pereopod I, ♂; B, pereopod I, ♀; C,D, pereopod I, ♂; E,F, pereopod IV, ♂, ♀. Scale bar 0.5 mm.

length, straight-curving dorsally; dorsal margin robust setae placed midlength, 6 robust setae (3 medially, 3 laterally). Exopod length 0.88 endopod length; exopod dorsal margin with 1 robust seta.

Sexual dimorphism, female differences from male. *Antennula* length 0.1 body length, with 10 articles. *Antenna* length 0.35 body length; flagellum length 0.65 total antenna length, with 16 articles. *Pereopod I* dactylus ventrodistal

Figure 20. *Platypyga subpetrae* n.gen., n.sp. A,B, paratype ♂ (AM P61457); C–F, paratype ♂ (AM P61460). A,B, pereopod II; C, pereopod V; D–F, pereopod VII. Scale bar 1 mm.

margin with row of sharp spines, along 0.53 total length; propodus dorsal margin proximal region not protruding beyond distodorsal margin of carpus, propodal palm with stout serrate setae, 8 altogether; stout robust simple setae absent; with 2 elongate broad based setae. *Pereopod IV* propodus with 2 broad based setae on ventral margin. *Uropod* total length 1.16 pleotelson length; endopod with 7 robust setae (4 medially, 3 laterally); exopod length 0.72 endopod length.

Remarks. Females of *Platypyga subpetrae* n.gen., n.sp. in our two samples (WA-564, WA-603) are rare and smaller than males. These specimens are smaller than the males from WAM C 23271 or AM P60540 (Bluff Knoll specimens, W. Ponder collection). The latter collection has larger individuals (greater than 20 mm), with an increased number of robust setae on the terminal lobes of the pleotelson, than the WAM C 23271 specimen. These larger specimens also differ from the type material in having the uropodal endopod longer than protopod. This feature, however, is not readily discernible without careful measurements. Until further evidence is available, we assume that all material examined is conspecific.

General distribution and habitat. Stirling Range National Park, Western Australia; rocky spring-fed streams flowing from south-facing slopes of the highest peaks of the Range.

Discussion

Epibionts. Most phreatoicideans have many microscopic organisms living on the external cuticle. Loricate peritrichs (Ciliophoran "protozoans"), commonly occur on various parts of the body (e.g., Figs. 3A,D,E, 10B, 12C; Fernandez-Leborans & Tato-Porto, 2000; J. Clamp, pers. comm.). Recent examples include the Lagenophryidae genus *Operculigera* found on *Colubotelson joyneri* (Clamp, in preparation), as well as *Vorticella* on a new phreatoicid genus from the Grampians (Victoria) (Wilson & Keable, in press). Aloricate ciliophorans may attach as cysts on pleopods, observed in *Phreatoicus typicus* (Clamp, pers. comm.). Metazoans also use phreatoicideans as a substrate.

Figure 21. *Platypyga subpetrae* n.gen., n.sp. A, paratype (AM P61559); B,C, paratype ♂ (AM P61457); D, paratype ♀ (AM P61458); E,F, paratype ♂ (AM P61460). A, pleotelson, posterior view; B,C, pleotelson; D, uropod; E, pleopod I; F, pleopod II endopod and appendix masculina. Scale bar 0.5 mm.

Temnocephala (Platyhelminthes Turbellaria Rhabdocoela) are common on *Phreatoicopsis* Spencer & Hall, 1897 species, typically on the sternites of the pereon (Wilson & Keable, in press). Cuticular hair of *Peludo paraliotus* n.gen., n.sp. (from sample WA-597) yielded small ostracodes (AM P60541, on slide). Most of these epibionts appear to use the isopods as a substrate, and do not appear to damage the host, at least externally. Because phreatoicideans do not

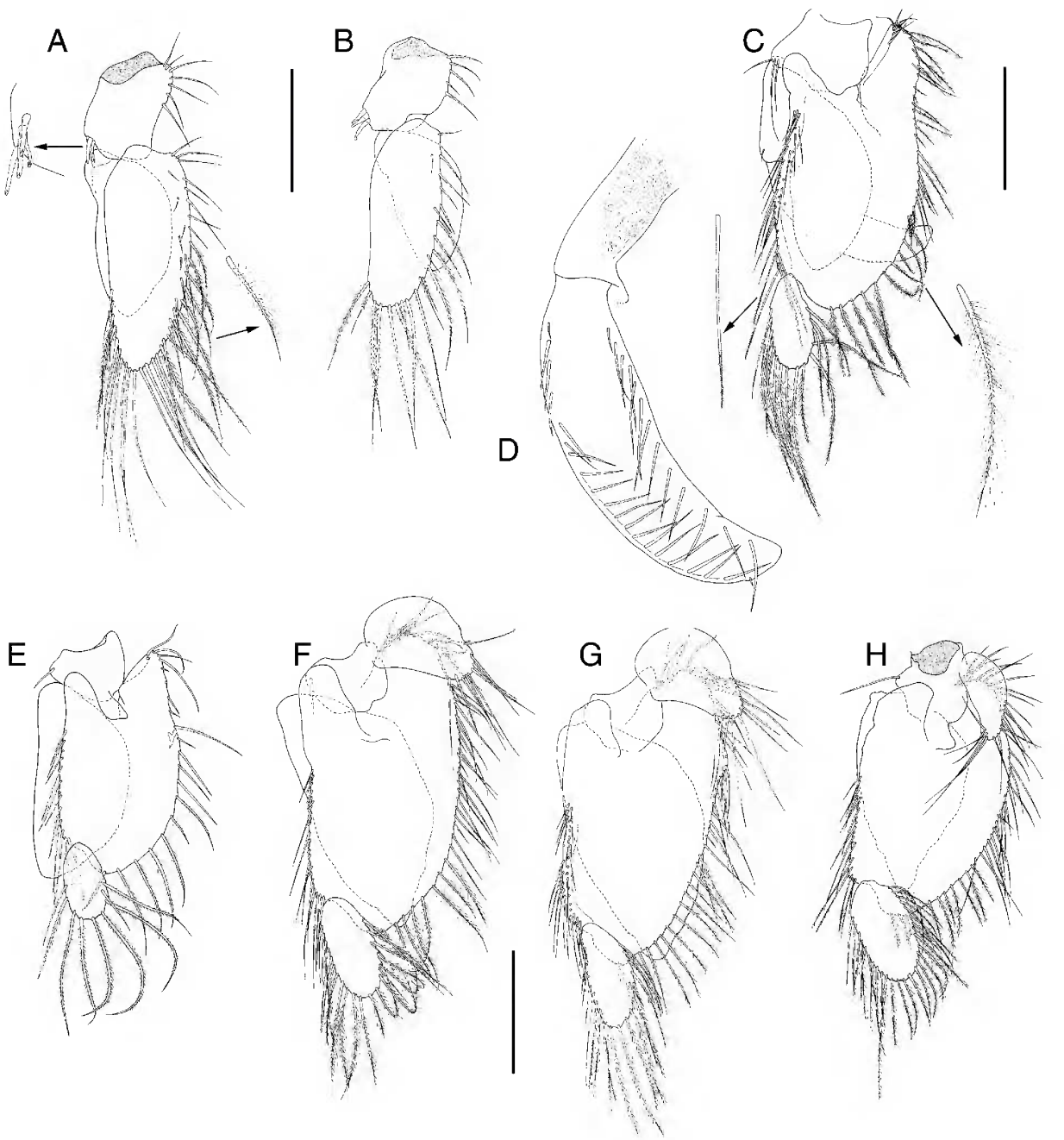

Figure 22. *Platypyga subpetrae* n.gen., n.sp. A,C,D,F–H, paratype ♂ (AM P61459); B,E, paratype ♀ (AM P61458). A,B, pleopod I; C–E, pleopod II; F–H, pleopods III–V. Scale bar 1 mm.

swim well, the sometimes dense infestations of ciliates do not appear to hydrodynamically disadvantage the isopods. The ciliates and the ostracodes attach firmly to the specimens and are not dislodged by our normal SEM preparation procedures.

Conservation. Similar to other recently discovered phreatoicidean taxa from the state of Western Australia (e.g., *Crenisopus* Wilson & Keable, 1999 and *Pilbarophreatoicus* Knott & Halse, 1999), each of the new genera is apparently endemic to a small region of the state. These taxa are therefore vulnerable to extinction, although to varying degrees.

Peludo paraliotus n.gen., n.sp. is restricted to two distinct coastal wetlands in Cape le Grand National Park, east of Esperance. This genus, however, may be more widespread along the south coast than our limited sampling effort suggests. Although our largest collections were made from streams flowing out of the coastal wetlands, we suspect that the main populations occur in the wetlands themselves, and are more insulated from visitation to the Park. Owing to this species occurring in a well-protected national park, it is possibly less vulnerable than the other species.

Platypyga subpetrae n.gen., n.sp. has been found only on the southern facing slopes of the Stirling Range, with at least two distinct localities (below Toolbrunup Peak and below Bluff Knoll). This species occurs in the well-protected Stirling Range National Park, so threats to its continued existence are likely to be low. The type locality is a stream flowing from the scree slope, next to the well-used trail to the summit of Toolbrunup Peak, so it is potentially

vulnerable to increased levels of visitation of the park. The main population of this species, however, may live under the scree slope and therefore could be insulated from any negative impacts.

Eremisopus beei n.gen., n.sp. is the most highly restricted of the three genera: it occurs only in a single stream, "South Creek" flowing west from the Frederick Hills, north of Kalumburu Township in the NW Kimberley region. The limited distribution of this species and its unprotected location makes it extremely vulnerable to any changes that affecting this spring-fed creek. The protection and continued existence of this species requires immediate consideration by the relevant authorities in the state.

Diversity and biogeography in Western Australia. Western Australia now has eight distinctive genera, a surprising level of phreatoicidean diversity considering its overall aridity. These taxa include: *Amphisopus* Nicholls, 1926; *Eremisopus* n.gen.; *Paramphisopus* Nicholls, 1943; *Peludo* n.gen., *Platypyga* n.gen. in the Amphisopodidae; and *Pilbarophreatoicus* Knott & Halse, 1999; *Hyperoedesipus* Nicholls & Milner, 1923 in the Hypsimetopodidae and *Crenisopus* Wilson & Keable, 1999; (see Wilson & Keable, 2001 for discussion of the classification). Based on our recent collections (unpublished data), much undescribed species-level diversity may be present in the genera *Amphisopus* and *Paramphisopus*. *Pilbarophreatoicus* also may include at least two additional undescribed species. This generic diversity is equivalent to that of Tasmania, a much wetter state. Western Australia has a huge area compared to Tasmania, and has many unexplored relict aquifers (Humphreys, 2001) where unique taxa could still be found. We predict that additional taxa of phreatoicideans will be found in this state as permanent groundwaters become better known.

The Western Australian phreatoicidean fauna is also phylogenetically distinct, with taxa in two of the three major clades of phreatoicideans present. No Phreatoicidae are known to occur in Western Australia while Amphisopodidae and Hypsimetopodidae also occur in southeastern Australia. Basal phreatoicideans appear to have been established in Western Australia prior to the diversification of the phylogenetically more derived Phreatoicidae, which are common in southeastern Australia, Tasmania and New Zealand (South Island) (Wilson & Keable, 2001). Interestingly, no Amphisopodidae or Hypsimetopodidae are known from New Zealand, and no Amphisopodidae occur in Tasmania. The explanations for this pattern are undoubtedly historical, and may related to separate centres of diversification within East and West Gondwana during the early Mesozoic. The pattern suggests that the Amphisopodidae and Hypsimetopodidae (Africa, India, western and northern Australia—no data from South America) evolved in East Gondwana, while the Phreatoicidae (SE Australia, Tasmania, New Zealand) evolved in West Gondwana. The zone of overlap and post-Mesozoic mixing between these two faunas, therefore, would include SE Australia and Tasmania. A cladistic test of these hypotheses using many different taxa should address these hypotheses.

ACKNOWLEDGMENTS. This research was generously supported by the Australian Biological Resources Survey and the Australian Museum Centre for Evolutionary Research. Cameron Bee, on the advice of Martyn Robinson, brought *Eremisopus* to our attention, and gave us the initial collection of specimens used in this paper. Anna Cerra and Francis Chee captured hundreds of SEM images, some of which were used in this paper. Our field trips to Western Australia were successful owing to the participation of Tristan Wilson, Kathy Fries-Wilson, Regina Wetzer and Winston Ponder. Staff of the Western Australia Department of Conservation and Land Management provided advice and assistance for our field trips. Di Jones and Melissa Hewitt (Western Australian Museum) kindly assisted with loans of various phreatoicideans and registered our new taxa. Kathy Fries-Wilson suggested the name "*Peludo*" for the "furry" isopods from Cape le Grand. Useful improvements to the manuscript were suggested by Dan Bickel, Gary Poore and an anonymous referee. This paper is a contribution of the Australian Museum Centre for Evolutionary Research. We gratefully thank all these individuals and institutions for their contributions to this research.

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Manuscript received 20 October 2000, revised 3 April 2001 and accepted 9 April 2001.

Associate Editor: Daniel J. Bickel.